This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

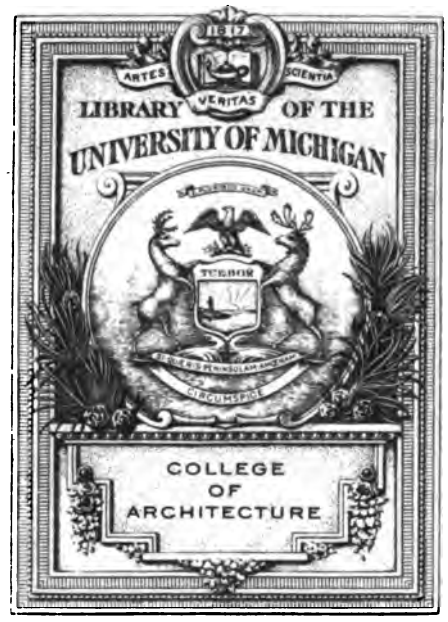
+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`


1817
ARTES
SCIENTIA
VERITAS
LIBRARY OF THE
UNIVERSITY OF MICHIGAN
COLLEGE
OF
ARCHITECTURE

Arch. .6.
NA
27
.E2

ARCHITECTURAL DRAWING

BY

C. FRANKLIN EDMINSTER

INSTRUCTOR IN DEPARTMENT OF FINE ARTS,

PRATT INSTITUTE, BROOKLYN, NEW YORK.

plate 60 lacking 9-1-43

FOURTH EDITION ENLARGED.

PUBLISHED BY THE AUTHOR.

COPYRIGHT, 1899, BY C. FRANKLIN EDMINSTER.
COPYRIGHT, 1902, BY C. FRANKLIN EDMINSTER.
COPYRIGHT, 1905, BY C. FRANKLIN EDMINSTER.

PREFACE.

This book is planned to meet the demand for a treatise on elementary architectural drawing. The material of which it is composed is in line with the evening work carried on at Pratt Institute. The order in which the subjects are here arranged need not be followed by the student. He should, if a beginner, commence with elementary work, such as problems in projection or in geometry. As a rule it would be unwise to spend the time requisite to perform all the geometric problems; but some of the more important ones will be found very helpful, especially in the matter of accuracy. From the work given, several courses can be mapped out to meet the varying demands.

The plates in the various subjects are arranged consecutively; that is, each new sheet presents a problem a little more difficult than that of the one preceding. For instance, in the study of the frame house the plan is first drawn, and with this as a basis, a complete study of all its details and framing is given, and in many instances more than one form of detail which might be used in the same position.

C. FRANKLIN EDMINSTER.

163090

CONTENTS.

CHAPTER		PAGE
I.	Notes on Materials	7
II.	Geometrical Problems	12
III.	Simple Projection, Introducing the Principles of Working Drawings	22
IV.	Intersection of Solids and Development of Surfaces	46
V.	Projection of Shadows	67
VI.	Instrumental Perspective	96
VII.	Orders of Architecture	120
VIII.	Study of a Frame House	162
IX.	Studies in Masonry Construction	212
X.	Stair Construction	226


ABCDEFGHIJKLMNOPQRSTUVWXYZ
ABCDEFGHIJKLMNOPQRSTUVWXYZ
a b c d e f g h i j k l m n o p q r s t u v w x y z
ABCDEFGHIJKLM
NOPQRSTUV
WXYZ
1 2 3 4 5 6 7 8 9 0

ARCHITECTURAL DRAWING.

CHAPTER I.

NOTES ON MATERIALS.

The student beginning the study of architectural drawing should provide himself with the necessary instruments of a good quality. He should not be hampered by using inferior materials, as many difficulties will arise under even the best conditions.

Drawing Boards.—One of the best methods of making a drawing board is to glue together narrow strips of boards, fastening two cleats (about two inches wide) across the back in such a way that there will be perfect freedom for the wood to expand and contract, which it surely will do as the humidity of the atmosphere changes. This freedom may be obtained by cutting slots in the cleats through which the screws pass and placing iron washers under the heads of the screws. A much cheaper board can be constructed by securing narrow pieces across each end, which serve to hold the board from warping. This form of board will answer very well, especially if the paper used is not stretched. It is extremely important that one end and one side of the board should be perfectly straight.

Drawing Paper.—Drawing paper that is to be used for general draughting and line work in pencil or ink should have a firm, smooth surface that is not easily roughened when erasures are made. As a rule, paper that is well adapted to line work will not receive a flat wash readily. Paper suitable for wash drawings is made with a surface less firm but rougher than for line work. Whatman's cold pressed paper possesses unusual properties, in that it works

well for both line and wash drawings. For general detail work, some of the tinted papers are more pleasant to work upon than white, as the white is rather trying to the eyes, especially when used in the evening. For highly finished drawings, however, white paper is generally preferred. The right side of the paper can usually be determined by holding it to the light and finding the water-mark, which should read correctly on the side used. Drawing paper may be obtained in sheets of standard sizes as follows: Cap, 13″ x 17″; Demy, 15″ x 20″; Medium, 17″ x 22″; Royal, 19″ x 24″; Super Royal, 19″ x 27″; Imperial, 22″ x 30″; Elephant, 23″ x 28″; Atlas, 26″ x 34″; Double Elephant, 27″ x 40″; Antiquarian, 31″ x 53″; Emperor, 48″ x 68″. The above terms apply only to the sizes of the sheets, and not in any way to grade or quality of the paper.

T-Square.—The T-square is made of two parts, the head and blade, which are fastened together at right angles to each other. This instrument should be used for drawing horizontal lines only, always holding the head against the left-hand edge of the board. Should the draughtsman allow himself to use either left or right side of the board at will, the results obtained would be very inaccurate, owing to the fact that two ends or sides of the board are seldom, if ever, parallel. Again, many times the T-square blade does not form right angles with the head. One may readily see that horizontal lines drawn under such conditions would not be parallel.

Triangles.—The draughtsman should provide himself with two triangles; the 45°, and the 30° and 60°. The triangles are used for drawing all lines that are not horizontal. Vertical lines should always be drawn by placing the triangle on the upper edge of the T-square blade, holding the pencil or pen in a plane perpendicular to the surface of the paper, inclining it slightly, and drawing upward, but never downward. In drawing horizontal lines, the pencil or pen should be held in a plane perpendicular to the paper, inclining it slightly to the right. Draw from left to right. Angles of 45°, 30°, 60° and 90°, with a horizontal line, can be drawn at once by placing the triangle on the T-square blade.

Instruments.—Instruments should be selected with the greatest care. It is much better to have a few pieces of excellent quality than a great number of inferior make. Choose quality rather than quantity. Instruments should be well cared for, properly wiped each time after using, and the points prevented from

contact with hard substances which will tend to injure them.

Compasses.—When drawing with the compasses the head should be held lightly between the thumb and two fingers, moving the leg containing the lead in the direction traversed by the hands of a clock, inclining it slightly in the direction of the line to be drawn. The joints in the legs should be so adjusted as to keep the lower sections perpendicular to the surface of the paper, and when a circle is of such a size as will not admit of this the lengthening bar should be inserted.

Ruling Pen.—The ruling pen is a very important instrument and should be made of the very best hardened steel; if not, it will give the student endless trouble. Most of the prepared inks in general use are provided with a quill in the cork of the bottle which lifts a certain amount of ink. The quill may be inserted between the nibs of the pen and the ink allowed to flow into the pen. The ink should not be more than one-fourth of an inch deep between the nibs. Clean the pen frequently by immersing it first in clear water and then passing a piece of cloth or chamois skin between the nibs. The pen should never be put away after using without being thoroughly cleansed.

Pencil.—The character of the work performed by a student is greatly influenced by the condition in which he keeps his pencil. It is impossible to do accurate work with a dull point. For all rule work the wedge-shaped point possesses an advantage over the round point, in that it has a greater wearing surface, hence will not require sharpening so often. For all freehand work nothing but the round or conical point should be used. Some draughtsmen prefer this point for rule work as well. The wood should be cut well back, leaving at least one-fourth of an inch of the lead exposed. One of the best sharpeners for a pencil is a fine flat file, on which the lead should be frequently applied, to produce a sharp point. Where great accuracy is required, the beginner should use a 4 H or 6 H pencil. As skill in draughting is acquired, a softer grade may be substituted. A medium grade pencil should be used for lining-in the drawings where strength of line is required.

The Scale.—A scale is an instrument used in reducing a drawing that would otherwise be too large for the sheet of paper on which it is to be placed. For instance, if we have a house measuring 40 x 60 ft., the drawing may be made on a scale of $\frac{1}{4}$ of an inch to 1 ft. The space occupied upon the plate would be

10 x 15 in., exactly in proportion to the actual size. In using this scale, or proportion, we have taken an actual $\frac{1}{4}$ of an inch and considered it 1 ft.; and this being taken as 1 ft. we divide it into 12 parts, each part being equal to 1 in. There will be found several different scales upon the instrument, all of which are divided in a similar manner.

Irregular Curve.—This instrument is used in drawing curves that cannot be accomplished by the use of the compass. Such curved lines usually pass through a succession of points which have already been found. The edge of the irregular curve should be so placed (by repeated trials) as to pass through as many points as possible and also a portion of the line already drawn. Never draw through the last point covered by the irregular curve. This operation requires a great deal of care in order to produce a perfectly smooth curve.

Penciling.—Too much stress cannot be placed upon the first penciling of a drawing. All drawings, whether to be inked-in or left in a strong pencil line, should first be worked out with a light line and very accurately placed. Many students have the feeling that they can correct the little errors while lining-in the drawing; this is not so, the chances being that they will greatly increase rather than diminish the faults.

Inking.—For highly finished drawings the stick India ink is generally preferred, but for ordinary work the prepared will be found satisfactory. The great advantage that stick ink possesses over the prepared is, that in case of error the line can readily be removed with the ordinary eraser. The disadvantage in using the stick ink is that considerable time each day is required to grind a fresh supply. In inking a drawing the student should ink all circles and arcs of circles first, then, beginning with the upper horizontal line, ink in order those below. With the vertical lines, begin on the left side of the plate and ink each line in succession. When several lines meet at a point always begin to ink from that point, allowing each successive line to dry before drawing another, thus preventing a blot that would otherwise occur at their junction.

Visible Lines.—The visible lines of an object are represented by a full black line.

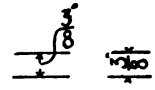
Invisible Lines.—Invisible lines or lines that are hidden are represented by a dash line, the dashes being about one-quarter of an inch long, the spaces between them being less than one-eighth of an inch.

This line should be of the same strength as a visible line.

Working Lines.—Working lines are used to obtain certain results, and if left in pencil should be very light, or if shown in ink, should be very light red or short dash black lines.

Arrow Heads.—Arrow heads should always be in black and made with great care, their points just touching the line to be measured.

Dimensioning.—In placing the dimensions it is always well to group as far as possible and not scatter them over the entire drawing. As a rule the same measurement should not appear in more than one view. The measurement line upon which the dimension is placed should not be drawn too near the line measured, usually about one-quarter of an inch away. It is customary to place all dimensions under two feet as inches, thus: 21″ (twenty-one inches), and for measurements over two feet as feet and inches, thus: 5′-6″ (five feet and six inches), or if in even feet, thus: 3′-0″ (three feet and no inches). When the space between two lines is not sufficient to place the measurements in the usual manner they may be placed thus:



Horizontal measurements should read from left to right, and vertical measurements should read upward. Great care should be taken in making figures, as the worth and appearance of the drawing depend greatly upon them.

CHAPTER II.

GEOMETRICAL PROBLEMS.

Prob. 1.—To bisect a given straight line A B.

From points A and B as centers and with any radius greater than half of the line A B, describe arcs above and below, intersecting in points 1 and 2. Draw a straight line through points 1 and 2, cutting the line A B at 3, thus bisecting the given line A B.

Prob. 2.—To bisect an arc of a circle A B.

From a point A as center and with any radius greater than half of curve A B, draw arcs above and below. With B as center and the same radius, cut the arcs already drawn in points 1 and 2. Draw a straight line through points 1 and 2, intersecting the curve A B in 3, which will bisect the given arc A B.

Prob. 3.—To bisect a given angle A B C.

With B as center and any radius, draw an arc cutting the lines B A and B C in points 1 and 2. With points 1 and 2 as centers and any radius greater than half of arc 1-2, describe arcs intersecting in point 3. Draw a line through points B and 3 which will bisect the given angle A B C.

Prob. 4.—To trisect a given right angle A B C.

With B as center and any radius, draw an arc cutting the sides of the right angle in points 1 and 2. With points 1 and 2 as centers and the same radius, draw arcs cutting in 3 and 4. Draw lines B 4 and B 3 which trisect the given right angle A B C.

Prob. 5.—To divide a given straight line A B into 6 equal parts (applicable for any number).

Draw the line A C at any angle to A B; lay off on this line 6 divisions, each equal to about $\frac{1}{6}$ of A B. Connect points 6 and B by a straight line. From points 1, 2, 3, 4 and 5, draw lines parallel with 6 B cutting A B in a, b, c, d and e.

Prob. 6.—To divide line A B into the same proportional parts as the given line C D.

From point A draw a line at any angle to A B. Lay off on this line the points corresponding to points on line C D. Connect points 4 and B. From points 1, 2 and 3, draw lines parallel with 4 B, cutting the line A B in a, b and c.

Prob. 7.—To divide a circle having the center given, into 6 equal parts.

Draw the diameter 1-5. With points 1 and 5 as centers and radius 1-2 describe arcs cutting the circle in points 3, 4, 6 and 7, which, with points 1 and 5, are the desired divisions.

Prob. 8.—From point A above the given line B C, draw a perpendicular to B C.

With point A as center and any radius, cut B C in 1 and 2. With 1 and 2 as centers and any radius, draw arcs below. From A draw a straight line to point 3, which is the desired perpendicular.

Prob. 9.—On a given line A B to erect a perpendicular at point A.

With point A as center and any radius, draw an arc cutting A B in 1. With 1 as center and the same radius, lay off points 2 and 3. With points 2 and 3 as centers and any radius, describe arcs above, cutting in 4. Connect points 4 and A, thus erecting the desired perpendicular.

Prob. 10.—To draw a line C D parallel to a given line A B at a given distance, as E F above it.

Erect perpendiculars at points 1 and 2 by Prob. 9, lay off on these the distance E F, giving points 3 and 4. Draw line C D through 3 and 4.

Prob. 11.—Through point C draw the line D E parallel to A B.

With point C as center and any radius, describe an arc cutting A B in 1. With 1 as center and same radius, describe an arc which will cut line A B in 2. With 1 as center and radius C 2, describe an arc cutting 1-3 in 3. Draw a straight line through points 3 and C, which will be the required line D E.

Prob. 12.—To construct an angle equal to a given angle B A C.

Draw the line D F. With A as center and any radius, describe an arc cutting the sides of the angle in points 1 and 2. With D as center and the same radius, describe an arc cutting D F in 3. With radius 1-2, and 3 as center, describe an arc cutting 3-4 in 4. Draw D E through D 4. E D F is the angle required.

Prob. 13.—Through point F draw a straight line which would meet the intersection of A B and C D if continued.

Draw F 1 and F 2 at any angle. Connect 1-2. From point 3 anywhere on A B make 3-4 parallel with 1-2, 3 E parallel with 1 F, and 4 E parallel with 2 F. Pass a straight line through points F and E, which will be the desired line.

Prob. 14.—Find the mean proportion between the two lines A B and C D.

Lay off on E F, 1-2 equal to A B and 2-3 equal to C D. Bisect 1-3 in 4. With 4 as center and radius 4-1, describe a semicircle. From 2 erect a perpendicular (Prob. 9) to E F, cutting semicircle in 5. 2-5 will be the desired mean.

Prob. 15.—On the given line A B to construct a square.

Draw B 1 perpendicular to A B (Prob. 9) and equal to A B. With points A and 1 as centers and A B as radius, describe arcs cutting in 2. Draw A-2 and 2-1.

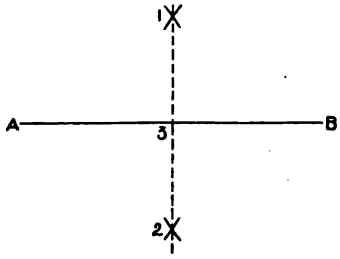
Prob. 16.—On a given line A B to construct an equilateral triangle.

With A and B as centers, and A B as radius, describe arcs cutting in 1. Draw A 1 and B 1.

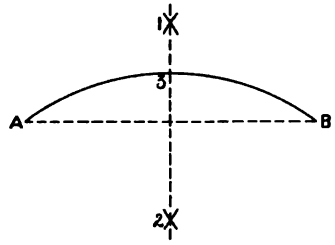
Prob. 17.—Having given the three sides of a triangle, as A B, C D and E F, to construct the figure.

With point B as center and the radius C D, describe an arc. With point A as center and E F as radius, describe an arc cutting the first in 1. Draw A 1 and B 1.

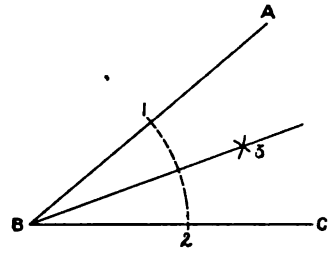
PROB. 1.



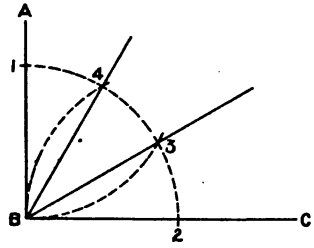
PROB. 2.



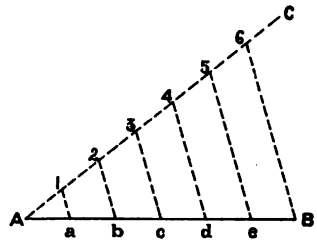
PROB. 3.



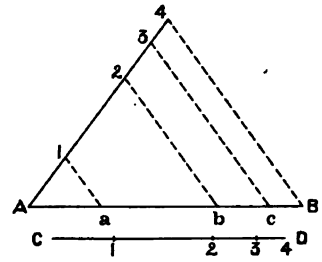
PROB. 4



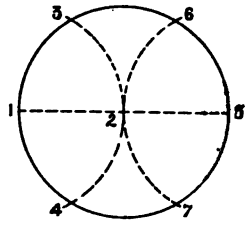
PROB. 5.



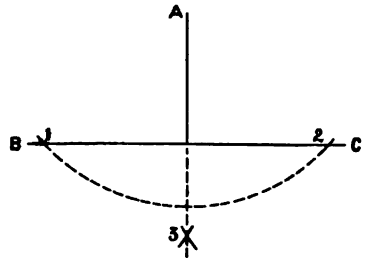
PROB. 6.



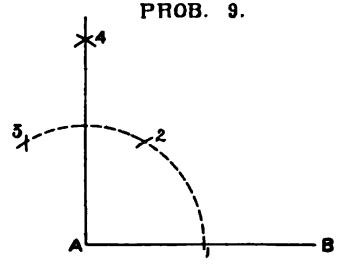
PROB. 7



PROB. 8.



PROB. 9.



Prob. 18.—On a given base A B to construct a regular hexagon.

With A and B as centers and A B as radius, describe arcs cutting in 1. With 1 as center and the same radius, describe a circle. A B is equal to $\frac{1}{6}$ of its circumference. Step off points 2, 3, 4 and 5, and draw B-2, 2-3, 3-4, 4-5 and 5-A.

Prob. 19.—Within a given square A B C D to inscribe an octagon.

Draw the diagonals A C and B D, intersecting in 1. With A, B, C and D as centers and radius A 1, describe arcs 2-3, 4-5, 6-7 and 8-9: draw 3-6, 5-8, 7-2 and 9-4.

Prob. 20.—On a given line A B to construct a pentagon.

With A and B as centers and radius A B, describe arcs cutting in 1 and 2. Connect 1 and 2. With 1 as center and the same radius, describe an arc cutting at 3, 4 and 5. Pass a line through 3-4 to 6, and one through 5-4 to 7. With 7 and 6 as centers and radius A B, describe arcs intersecting in 8. Draw A 7, 7-8, 8-6 and 6 B.

Prob. 21.—On a given base A B to construct an octagon.

Erect perpendiculars at A and B. Bisect the exterior angles and set off A 1 and B 2 equal to A B. Connect 1-2, cutting the perpendiculars in 3 and 4. Make 3-5 and 4-6 equal to 3-4. Extend line through 5-6 indefinitely. Make 5-7, 6-8, 5-9 and 6-10 equal to 3 A. Draw A 1, 1-7, 7-9, 9-10, 10-8, 8-2 and 2 B.

Prob. 22.—Within a given equilateral triangle A B C to inscribe a circle.

Bisect the angles of the triangle by Prob. 3. The bisectors will intersect in 1. The perpendicular distance from 1 to any side of the triangle will be the radius of the desired circle. Note, this problem is true in any form of triangle.

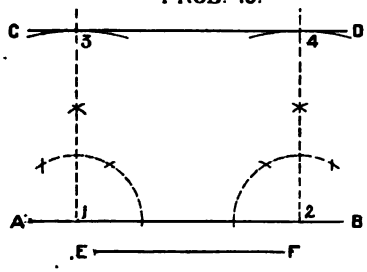
Prob. 23.—Within a square A B C D to inscribe four semicircles, each touching one side of the square and their diameters forming a square.

Draw diagonals A C and D B, intersecting in 1. Draw diameters passing through 1. Draw 2-3, 3-4, 4-5 and 5-2. Draw 6-7, 7-8, 8-9 and 9-6, which give us points 11, 12, 13 and 14, the centers of the required semicircles.

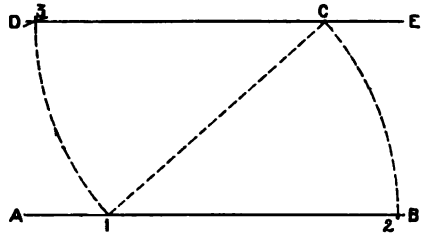
Prob. 24.—Within a given equilateral triangle A B C to inscribe three equal circles, each touching two sides of the triangle and two other circles.

Bisect the angles of the triangle, letting the bisectors cut the sides of the triangle in 1, 2 and 3.

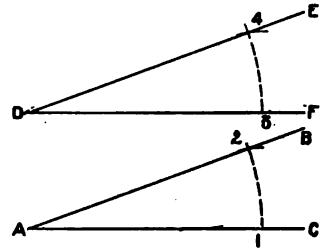
PROB. 10.



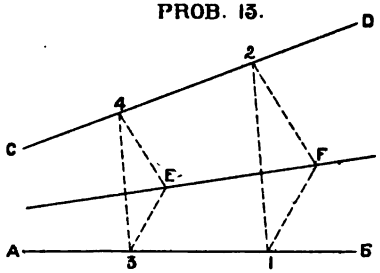
PROB. 11.



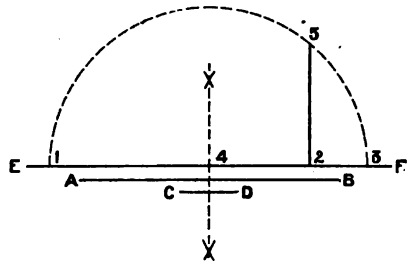
PROB. 12.



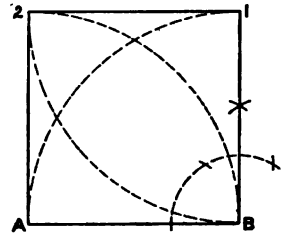
PROB. 13.



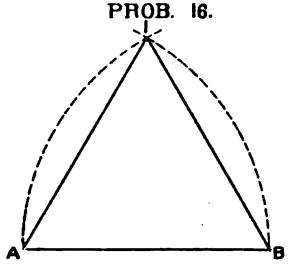
PROB. 14.



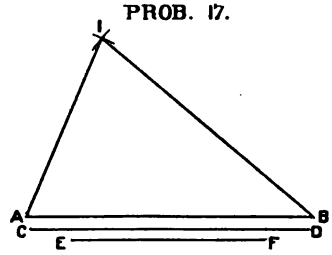
PROB. 15.



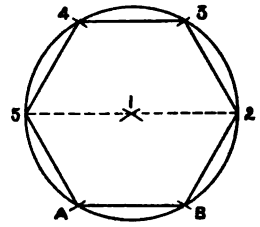
PROB. 16.



PROB. 17.



PROB. 18.



With centers 1, 2 and 3 and radius 1-2, describe arcs cutting bisectors in 4, 5 and 6, the centers of the required circles. A perpendicular (Prob. 8) from the center of any circle to the side of the triangle will determine the radius of the circle, and also the point of tangency.

Prob. 25.—Within a given circle to inscribe three semicircles, each touching the circumscribing circle, and their diameters forming a regular triangle.

Draw two diameters, 1-2 and 3-4 at right angles to each other, intersecting in 5. Divide the circle into twice as many parts as there are semicircles to be inscribed, beginning at 1. Draw diameters 6-7 and 8-9. Connect 2-3, cutting diameter 8-9 in 10, which locates one point of the required triangle. With 5 as center and radius 5-10, set off 11 and 12, which when connected form the triangle. Draw 10-11, 11-12 and 12-10, giving points 13, 14 and 15, the centers of the required semicircles.

Prob. 26.—Within a given square A B C D to inscribe four equal circles, each tangent to two others and two sides of a square.

Draw the diagonals and the diameters intersecting in 1 and giving points 2, 3, 4 and 5. Connect points 2-3, 3-4, 4-5 and 5-2, intersecting diagonals in 6, 7, 8 and 9, which will be the centers of the required circles.

Prob. 27.—Within a given circle to inscribe any number of equal circles which shall be tangent to two others and to the circumscribing circle. In this problem, five.

Divide the circumference of the circle into twice as many equal parts as there are to be circles inscribed. Produce the diameters on either side of 2-7 until they meet a perpendicular erected to 2-7 at 2. Bisect angles 12 and 13 and let bisectors cut diameter 2-7 in 14. With 1 as center and radius 1-14, draw a circle cutting diameters in 15, 16, 17 and 18, the centers of the required circles.

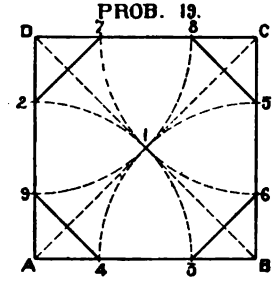
Prob. 28.—To draw a line tangent to a given circle through a given point A.

Pass a line through center 1 and point A indefinitely. With point A as center and any radius, cut this line in points 2 and 3. With 2 and 3 as centers and any radius, describe arcs cutting in 4 and 5. Connect 4 and 5, which will be the desired line.

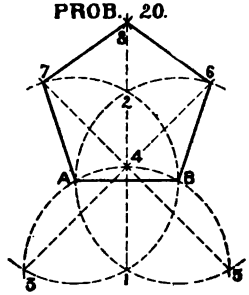
Prob. 29.—To draw a line tangent to a given point A in a circle when the center is not accessible.

Draw any chord A 1. Bisect the chord and arc (Probs. 1 and 2) in 2 and 3. With A as center and A 3 as a radius, draw an arc 4-5; with 3 as center and 3-5 as a radius, draw an arc cutting 4-5 in 4. Draw line through A 4 tangent to the circle.

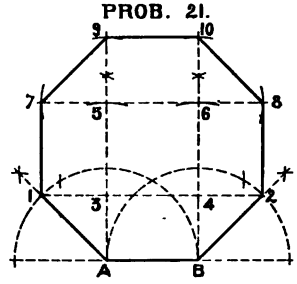
PROB. 19.



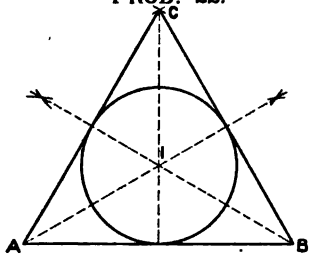
PROB. 20.



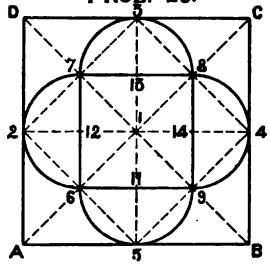
PROB. 21.



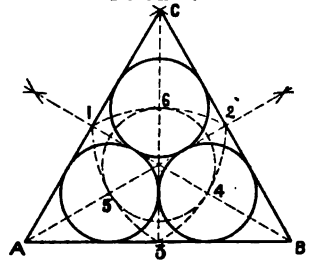
PROB. 22.



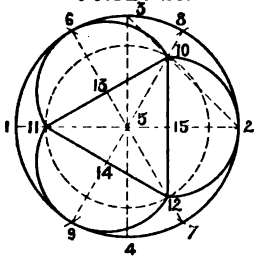
PROB. 23.



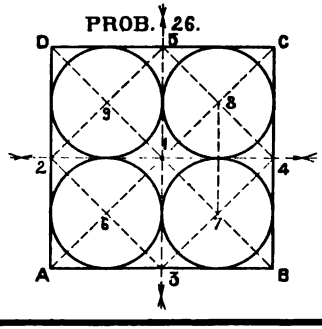
PROB. 24.



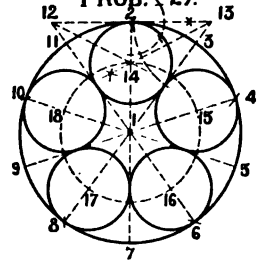
PROB. 25.



PROB. 26.



PROB. 27.



Prob. 30.—Draw a circle tangent to a given point C in line A B and through the fixed point D without the line.

At point C erect a perpendicular (Prob. 9). Connect C D and draw a perpendicular to its center (Prob. 1) intersecting the first perpendicular in 1, which is the center of the required circle.

Prob. 31.—Draw a circle tangent to a given circle A, also to a given line B C at a given point D in the line.

Pass a line through D perpendicular to B C. Lay off D 1 the length of the radius of circle A and draw A 1. Draw perpendicular to A 1 (Prob. 1) intersecting the line 1 D in 2, which is the center of the required circle. 3 and D are the points of tangency.

Prob. 32.—At a given point E in line D B draw two arcs of circles tangent at this point and to the two lines A B and C D.

Make B 1 equal to B E. Make D 2 equal to D E. Draw E 3 perpendicular to D B, 1-4 perpendicular to A B and 2-3 perpendicular to C D. Points 3 and 4 are the centers of the required arcs.

Prob. 33.—Having given parallel lines A B and C D, to connect by two arcs of circles which shall be tangent at points B and C and pass through point E, which is anywhere on line B C.

At B and C erect perpendiculars. Bisect B E and E C, intersecting the perpendiculars in 1 and 2, the centers of the required arcs.

Prob. 34.—To draw an ellipse by means of a trammel, having the axes given.

The semi-diameters of the ellipse are represented by A B and A C. Lay off on the straight edge of a piece of paper 1-2 equal to A B, also 3-2 equal to A C. Keeping point 1 on the short diameter and point 3 on the long, mark off as many points at 2 as desired to form the curve of the ellipse.

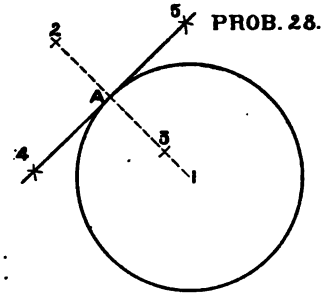
Prob. 35.—To draw a line tangent to an ellipse at any given point, as E, in the curve.

With point C as center and A 1 as radius, describe an arc cutting diameter A B in F and F′, which points are called foci. Extend a line from F′ through E indefinitely. Make E 2 equal to E F. Bisect the angle F E 2, giving the desired tangent.

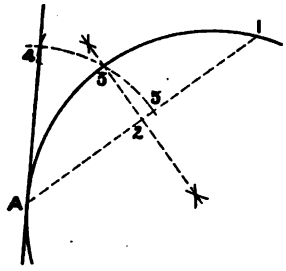
Prob. 36.—To draw a line tangent to an ellipse, passing through a given point E without it.

Find the foci as in Prob. 35. With point E as center and radius E F, describe an arc. With F′ as center and A B as radius, describe an arc cutting the first arc in points 1 and 2. Connect F′ 1 and F′ 2, cutting the ellipse in points 3 and 4. Draw lines from E through 3 and 4, which will be tangent at 3 and 4.

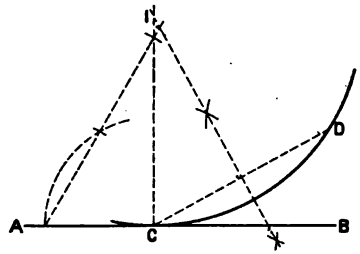
PROB. 28.



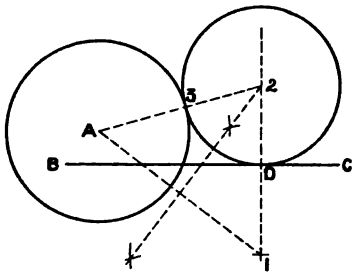
PROB. 29.



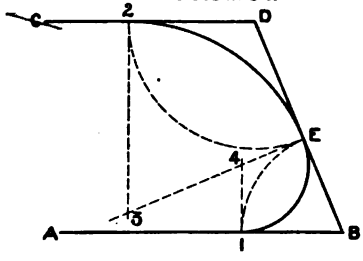
PROB. 30.



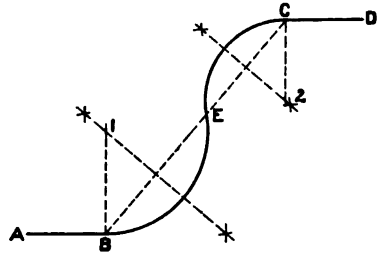
PROB. 31



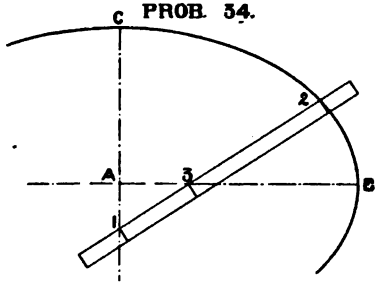
PROB. 32.



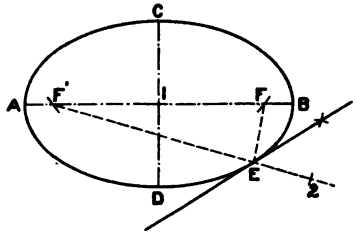
PROB. 33.



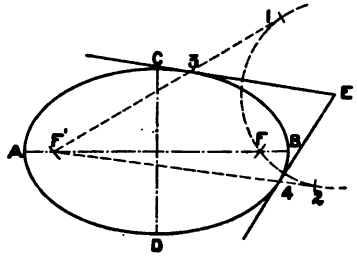
PROB. 34.



PROB. 35.



PROB. 36.



CHAPTER III.

SIMPLE PROJECTION, INTRODUCING THE PRINCIPLES OF WORKING DRAWINGS.

The working drawings of any object are such drawings, accompanied by the proper measurements, as will tell all the facts concerning that object. Such drawings if sent to a mechanic would be sufficient to enable him to perform the desired piece of work without further explanation. The number of views required depends entirely upon the character of the subject to be drawn; for instance, in Plate 5, Fig. 1, two views are sufficient to tell all that concerns the cube, whereas for a more complicated object three or even more views may be necessary to tell all the facts.

Plate 5.—To draw the front and top views of the cube in three positions.

Fig. 1 represents the cube so placed in the top view that two edges are parallel to an imaginary horizontal line. In drawing the front view we suppose the cube to be resting upon a horizontal plane upon one of its faces, and so placed as to appear as a square if seen directly in front. In the top view we are supposed to be looking down upon the cube, its position being unchanged. As noted before, the cube will be seen as a square in both the front and top views, and these should appear directly above one another. The space between the two views is immaterial, but should be such as to appear well on the sheet. The horizontal line should be drawn with a T-square, having its head against the left-hand edge of the board, whereas the vertical lines should be drawn with a triangle resting on the edge of the T-square blade. Only three measurements are necessary. They should be carefully placed as indicated in the drawings, the arrow heads just touching the extension lines from those that they measure, not overrunning or falling short.

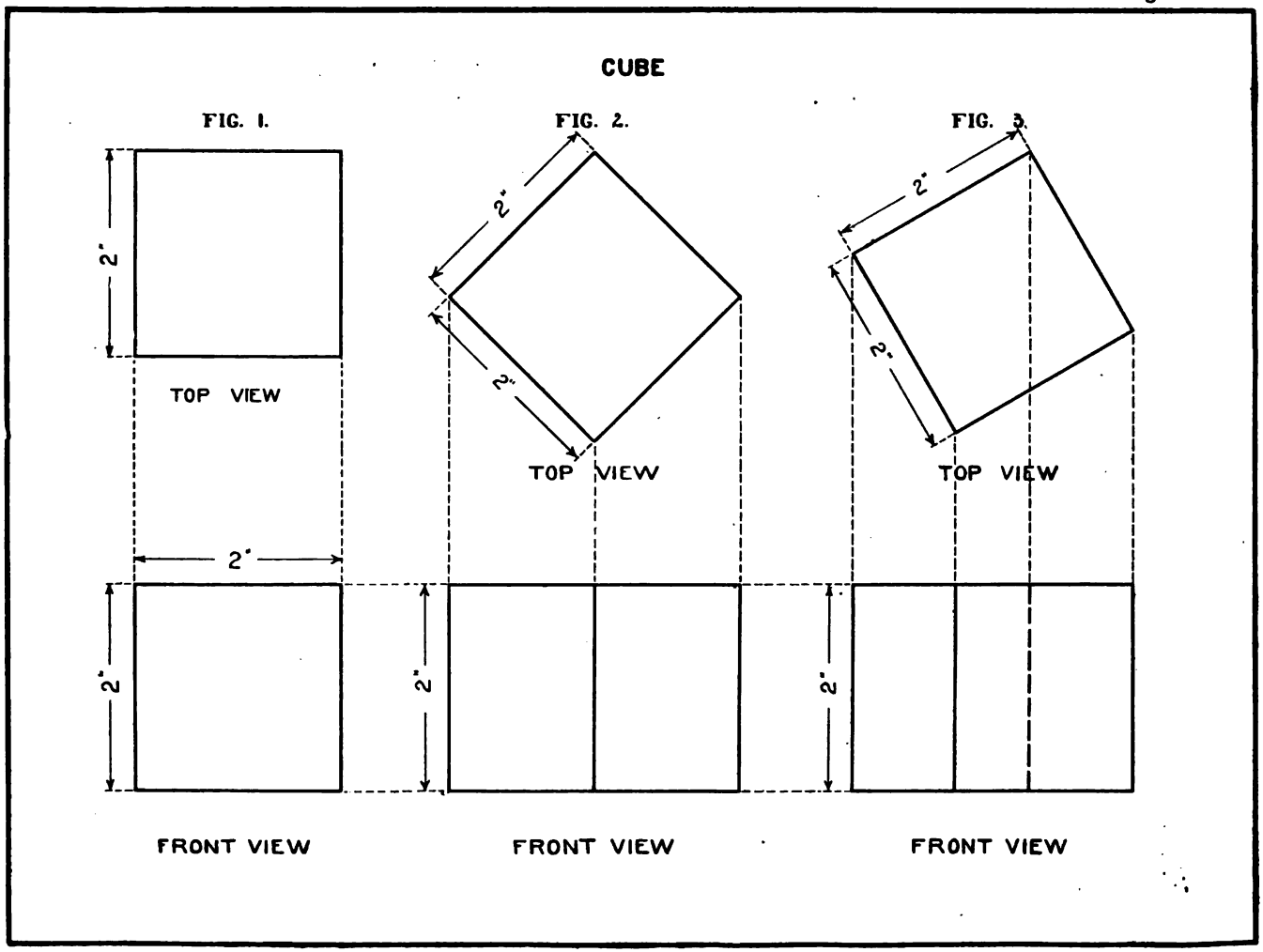

CUBE
FIG. 1.
FIG. 2.
FIG. 3.
2"
2"
2"
2"
2"
TOP VIEW
TOP VIEW
TOP VIEW
2"
2"
2"
2"
FRONT VIEW
FRONT VIEW
FRONT VIEW

Fig. 2 represents the cube turned in the top view so that its edges make angles of 45° with an imaginary horizontal line.

Fig. 3 represents the cube turned in a similar manner, but at angles of 30° and 60° with a horizontal line. In both of these figures the top views should be drawn first. From them project down and construct the front views directly opposite the front view in Fig. 1. These problems should be lined-in with a medium grade pencil, making the result lines, or, in other words, the outlines of the cubes, strong and black, uniform in thickness throughout the drawing, and much resembling an inked line. Extension lines should be at right angles to the lines to be measured, and measurement lines should be left light. Care should be given to printing and figuring, as the appearance of the sheet depends much upon this feature of the work. Figs. 2 and 3 are not necessary as working drawings of a cube, but are given as simple exercises for the use of the T-square and triangles, and as a method of representing foreshortened surfaces and of placing measurements upon inclined lines.

Plate 6.—Fig. 1 represents the front, top and side views of an equilateral triangular prism placed so that two of its faces are equally visible in the front view. In this drawing the top view should first be made, from which the front and side views are projected. The student should take notice that the width of the side view is equal to the altitude of the triangles formed by the top view and not to one of its sides, as many beginners are apt to suppose.

Fig. 2.—Draw the front and top views of a regular hexagonal prism according to the measurements given. In this, as in Fig. 1, the top view should be drawn first and the front view projected directly below. Both the triangle in Fig. 1 and the hexagon in Fig. 2 may be constructed by the use of the 30° and 60° triangle, or more accurately, by the use of the compasses as given in geometric problems 16 and 18.

TRIANGULAR AND HEXAGONAL PRISMS

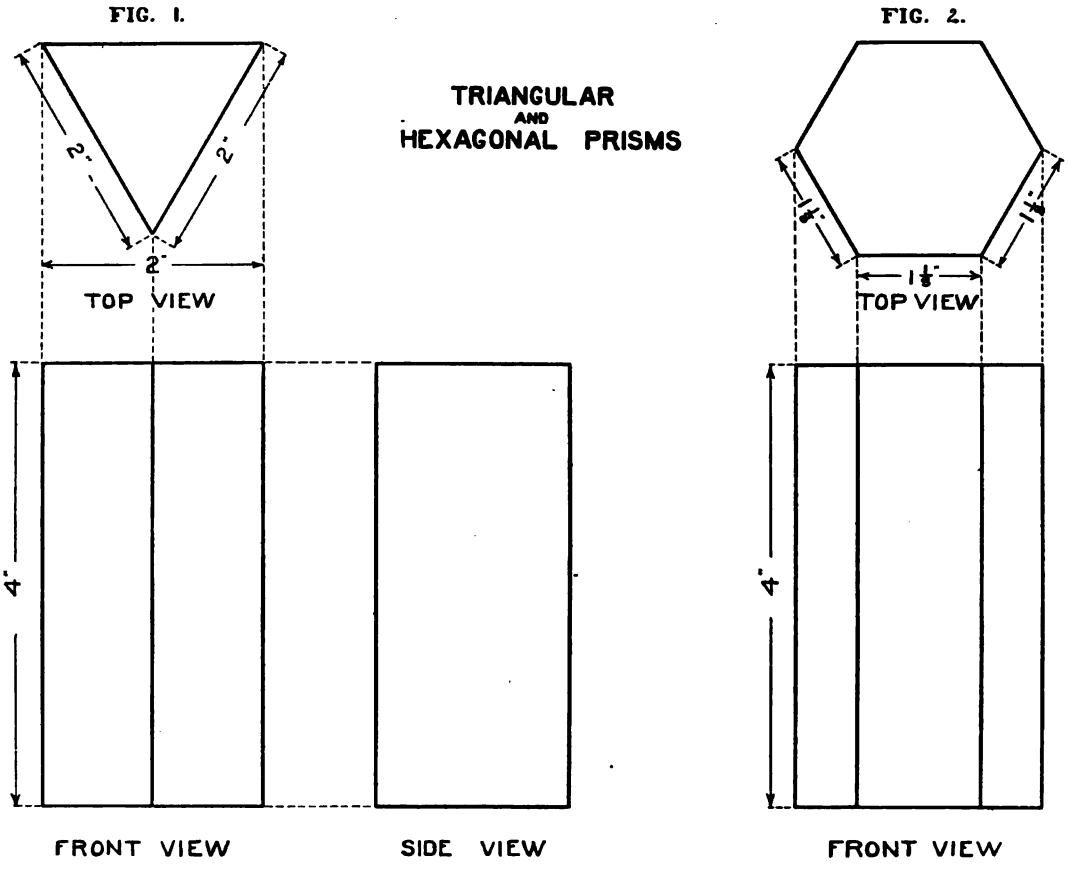


Plate 7.—The drawing at the left represents the front and top views of a square pyramid. Note that the height of the pyramid is given on a measurement line parallel to the axis and not parallel to the slant line of the pyramid.

The chimney model is represented by front and top views and a vertical section; this section is supposed to be cut through line A and the front half removed. The surface cut by this vertical plane is section lined at 45°. Different pieces of material adjoining one another are section lined in different directions as shown in this problem.

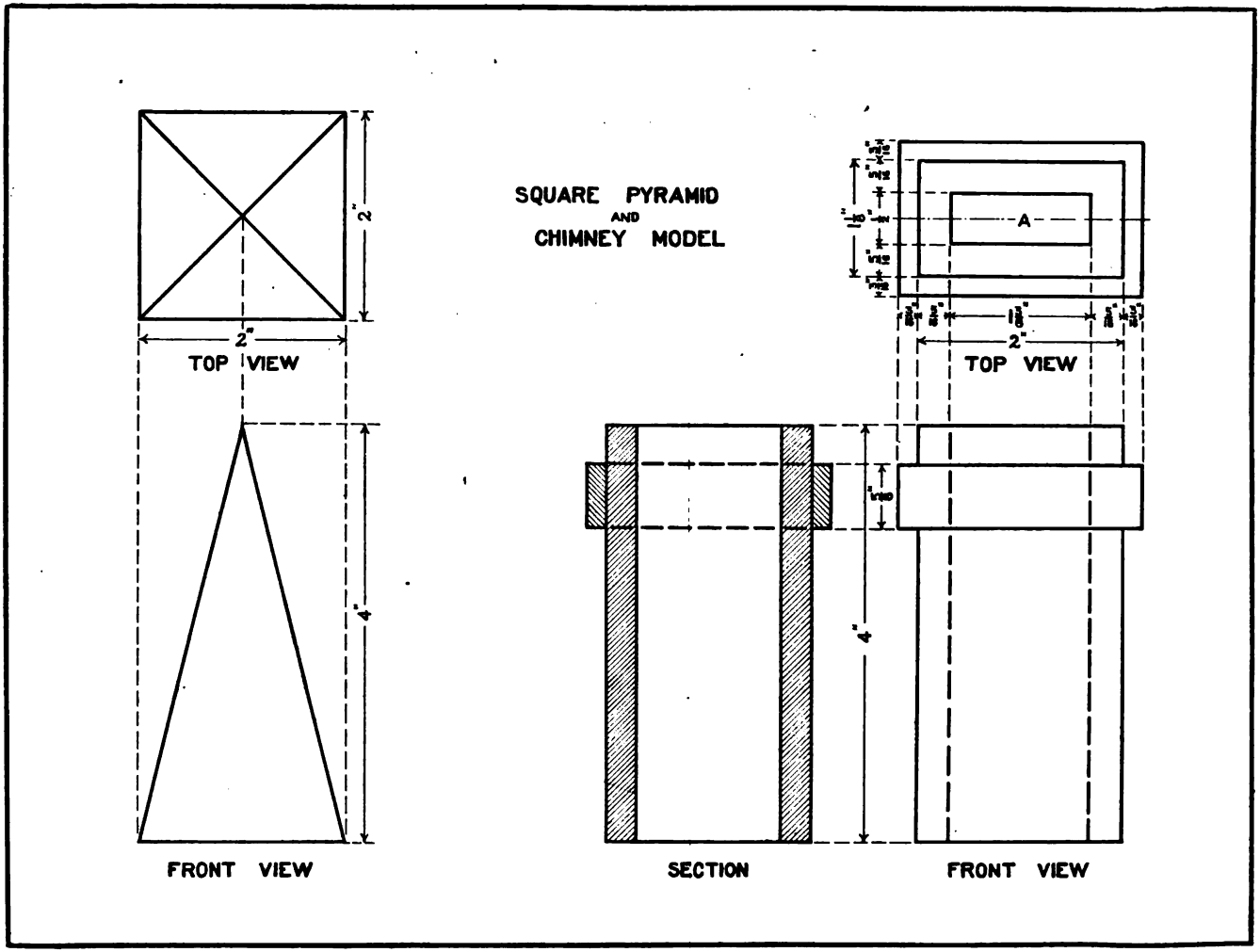

SQUARE PYRAMID
AND
CHIMNEY MODEL
2"
2"
TOP VIEW
4"
FRONT VIEW
A
2"
TOP VIEW
4"
SECTION
FRONT VIEW

Plate 8.—The drawing at the left represents the front and top views of a paneled prism turned at an angle of 30° and 60°. The top view should be drawn first; the main lines of the prism and the vertical lines of the panel may then be projected down to their respective places as indicated by the connecting lines. In the drawing at the right we have the front and top views, and a vertical section of a hollow flanged cylinder. The top view should be drawn first, as in nearly all cases when the object is based upon the cylinder. As but one piece of material is shown in the section, all the section lines run in the same direction. In mechanical drawings, the front view of objects based upon the cylinder are frequently represented half in elevation and half in section, instead of making a separate drawing of the section, as in this case.

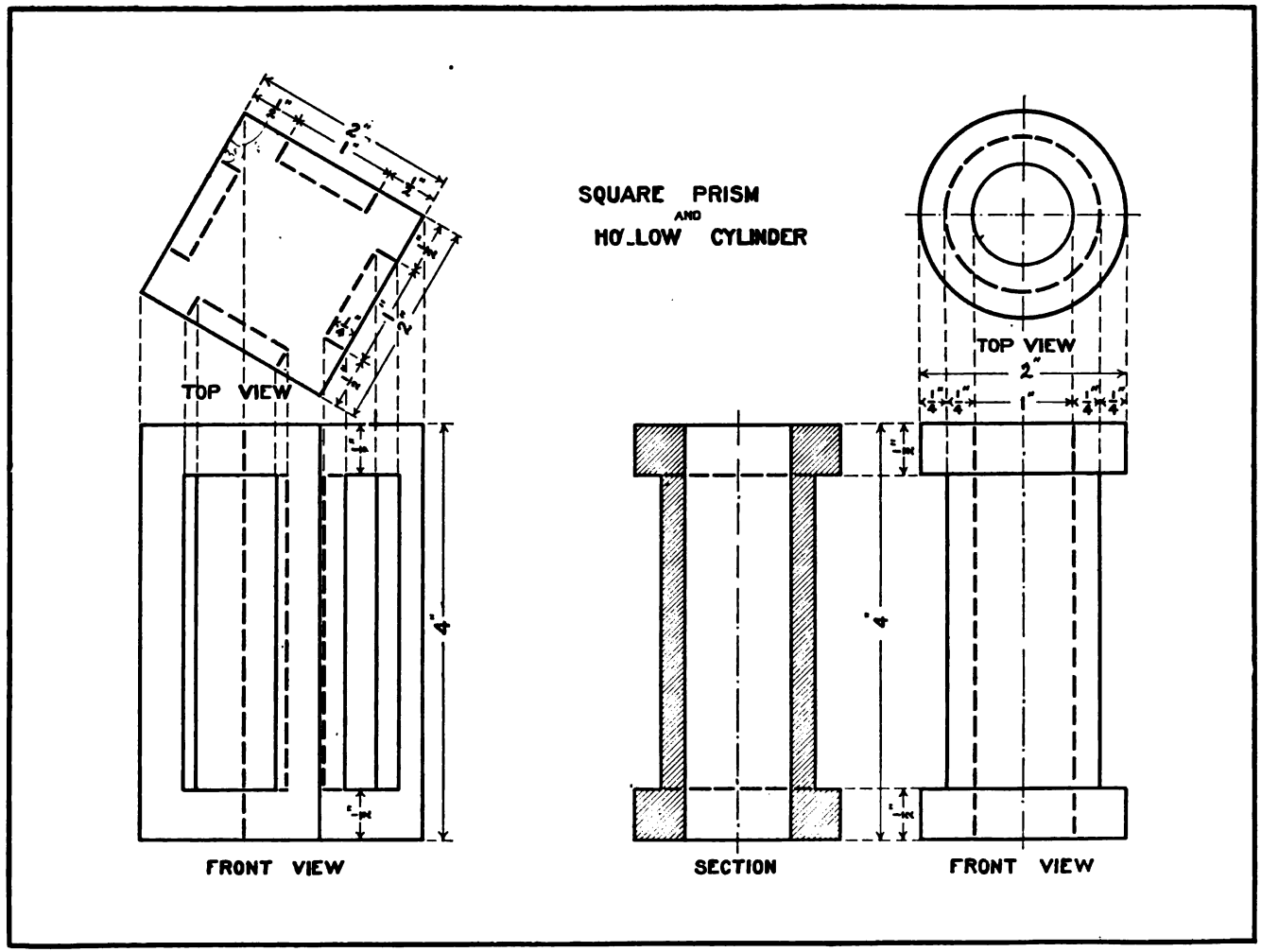

SQUARE PRISM
AND
HOLLOW CYLINDER
TOP VIEW
2"
1"
1/4"
1/4"
1/4"
1/4"
1"
2"
1"
4"
1/4"
FRONT VIEW
TOP VIEW
2"
1"
1/4"
1/4"
1/4"
1/4"
1"
4"
1/4"
SECTION
FRONT VIEW

Plate 9.—Draw the front, top, right and left side views of a cylinder and a cube, as placed in the drawing. Locate the top view, from which project points down, so placing the objects in the front view. The spaces A′, B′, C′, D′ and E′ of the right side view are equal to spaces A, B, C, D and E of the top view. The vertical heights in the side views are equal to those of the front.

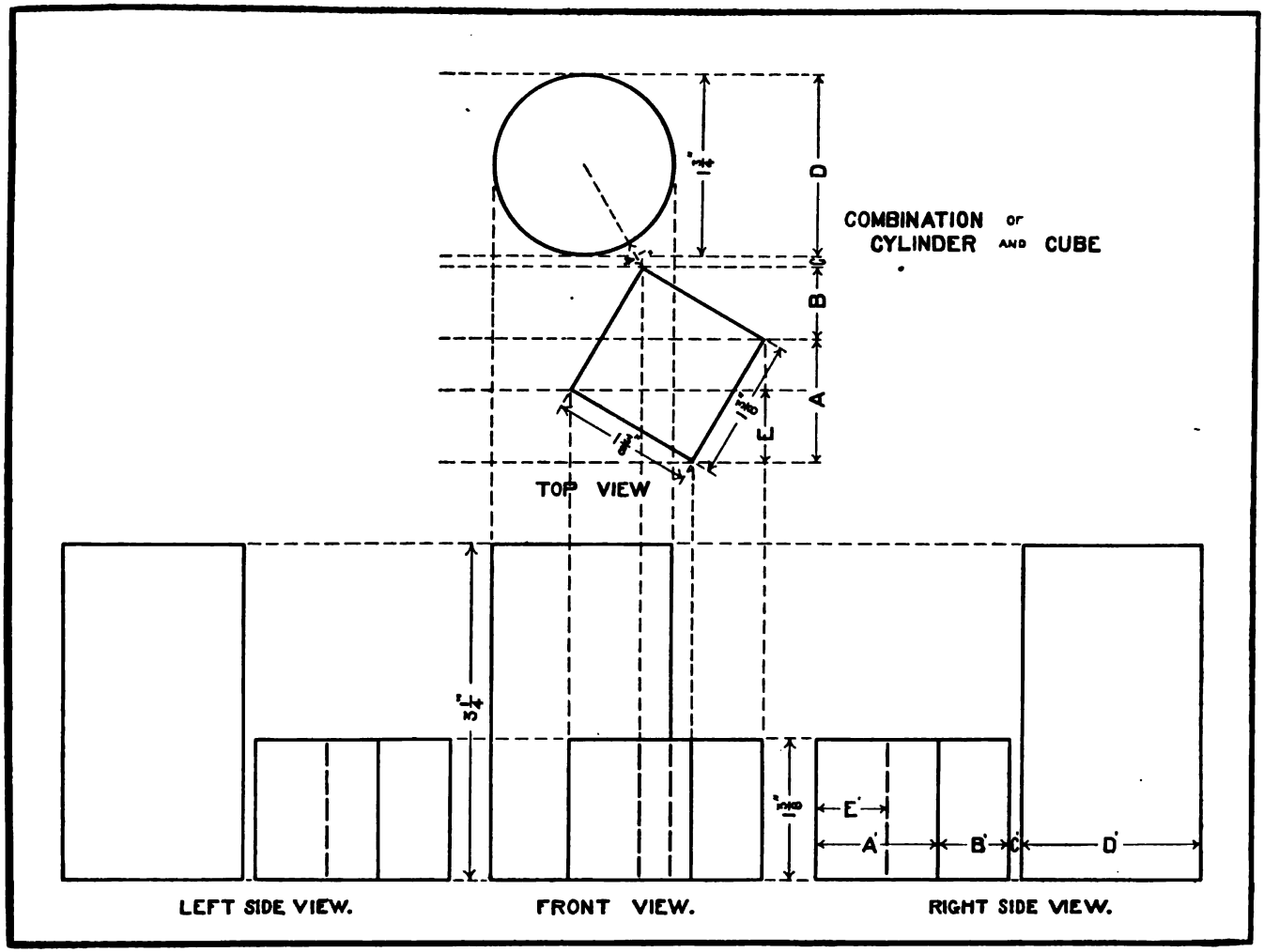

COMBINATION OF CYLINDER AND CUBE
D
B
A
E
TOP VIEW
LEFT SIDE VIEW.
FRONT VIEW.
RIGHT SIDE VIEW.
E'
A'
B'
C'
D'

Plate 10.—Fig. 1 represents the front and top views of a hexagonal prism. In the front view this object shows two of its faces equally and is so inclined that its base makes an angle of 30° with the horizontal plane. First, draw the front view, making the short lines at 30° and the long lines at 60°, and the distances A and B in the front view equivalent to A′ and B′ in the diagram Fig. 2; this diagram being a regular hexagon. In the top view the distances C, D and E are equal to C′, D′ and E′ in the diagram. Having obtained the position of these horizontal lines, project points in the front view to corresponding lines in the top view, giving points to be connected by straight lines.

Fig. 3.—The top view as shown in this figure is the same as in Fig. 1, but turned at an angle of 45°. The front view of this object in the turned position must be quite different in appearance from that in Fig. 1; but all its points will appear to be at the same height as before it was revolved. This being so, we have simply to project corresponding points in the top and front views until the lines intersect, giving the several points, which are connected by straight lines. For instance, point F may be traced from one view to another, as shown in the drawing.

HEXAGONAL PRISM

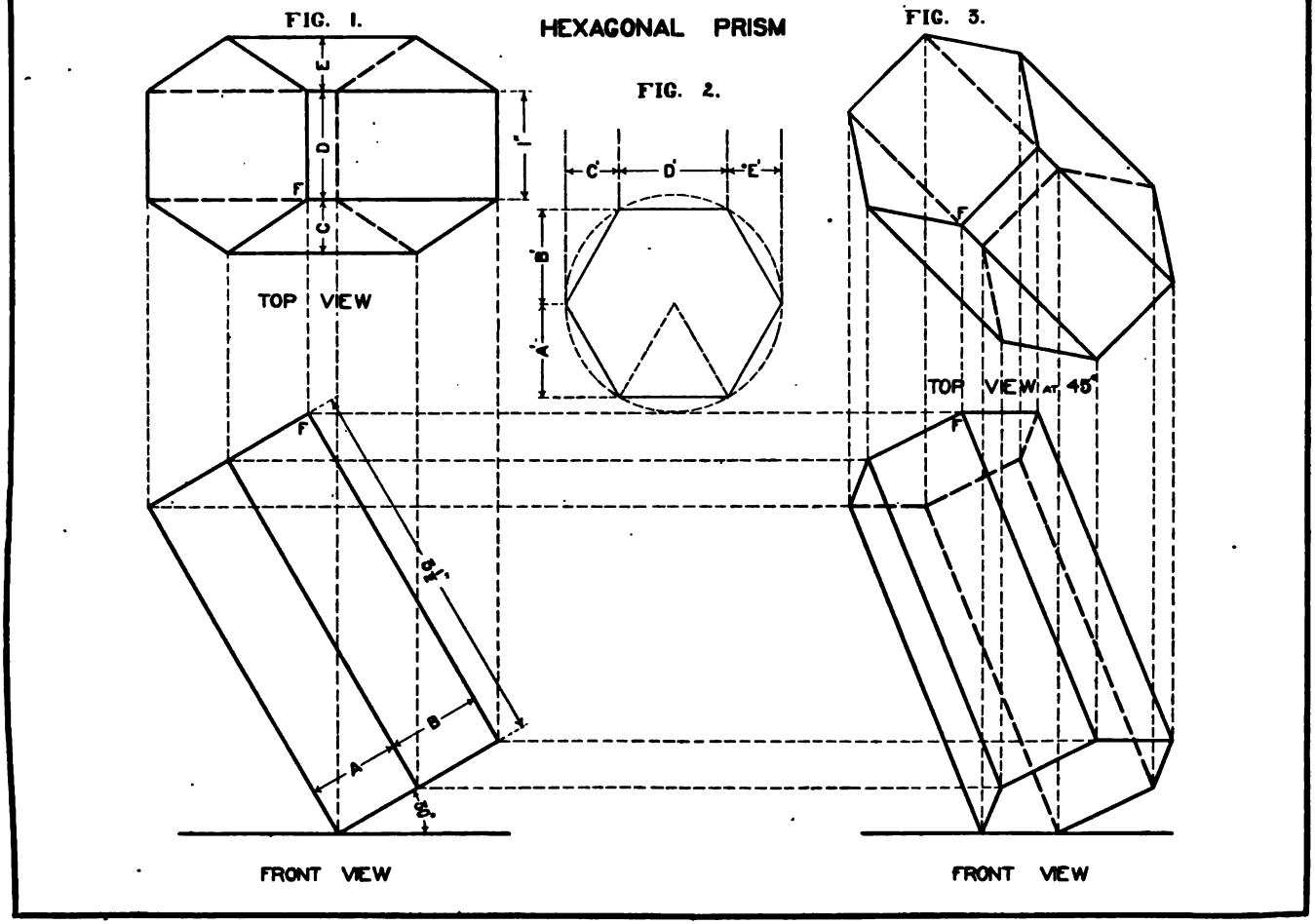


Plate 11.—Draw the front and top views of a square prism resting across a triangular prism according to given measurements. Draw the front view as shown, from which project the points of the triangular prism locating the top view. The points in the square prism are projected in a similar manner. Being a square prism the space between the two long edges in the top view equals one side of the prism. Transfer the top view to the right portion of the sheet at angles of 30° and 60°. Find the front view by projection, as in Plate 10.

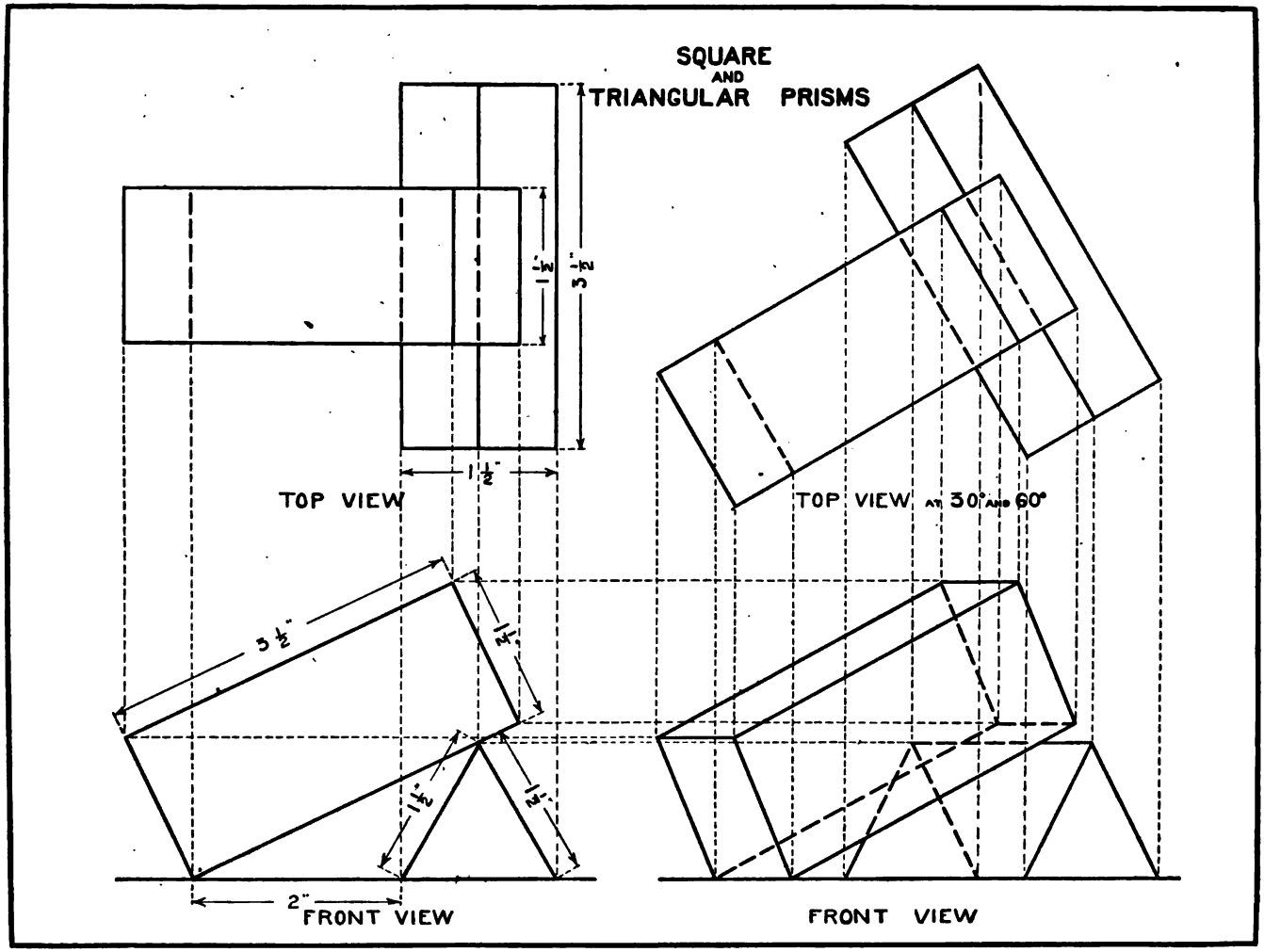

SQUARE
AND
TRIANGULAR PRISMS
1½"
3½"
1½"
TOP VIEW
TOP VIEW at 30° and 60°
3½"
1½"
1½"
1½"
2"
FRONT VIEW
FRONT VIEW

Plate 12.—In this plate we have the hexagonal prism resting across the square prism, their projections to be carried out precisely as in the plate preceding. To find the projection of the hexagonal prism as shown on the left portion of the plate, proceed as in Plate 11. Measurements should be placed only upon lines that are not foreshortened.

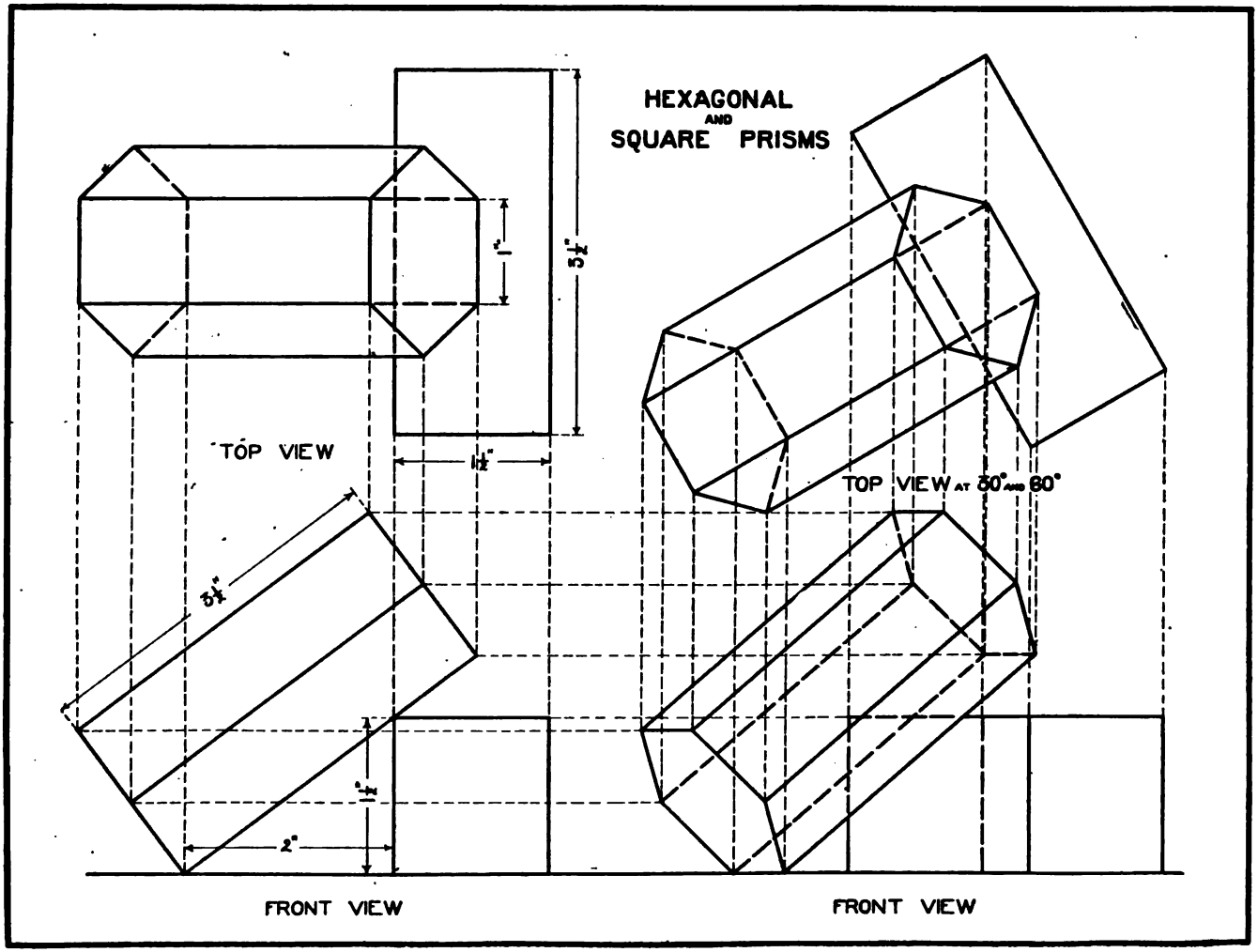
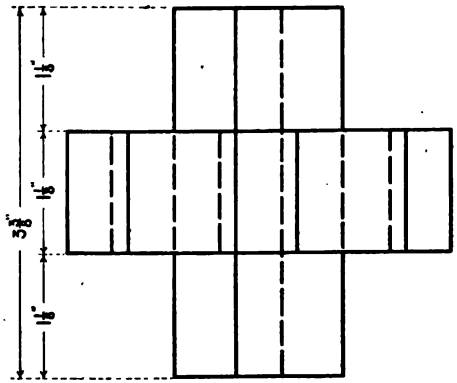
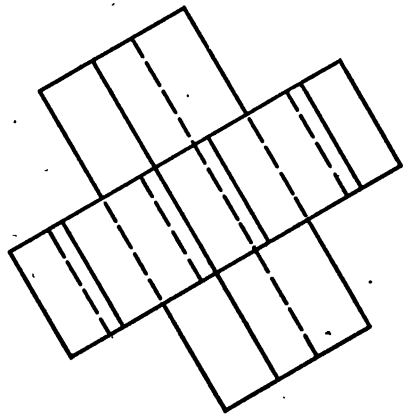

HEXAGONAL
AND
SQUARE PRISMS
1"
1½"
TOP VIEW
2½"
TOP VIEW AT 30° AND 60°
2½"
½"
2"
FRONT VIEW
FRONT VIEW

Plate 13.—This plate gives an excellent problem in projection; the student being obliged to follow each point carefully through the several views in order to produce correct results. Draw first the front and then the top view. Having completed the top view, transfer it to the right portion of the sheet, turning it at angles of 30° and 60°. The fourth view is found by projecting horizontally from the front view and vertically from the top view as in the foregoing drawings. Great accuracy is required to make this last result satisfactory.

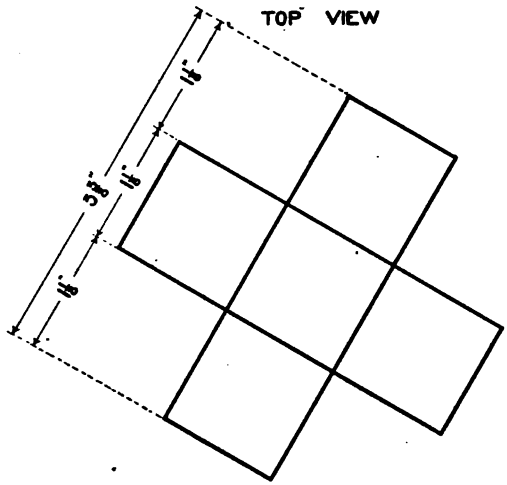
DOUBLE CROSS



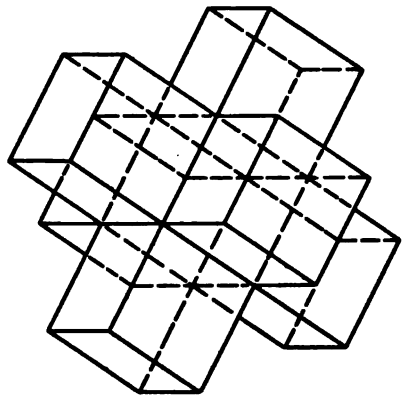
TOP VIEW



TOP VIEW AT 30° AND 60°

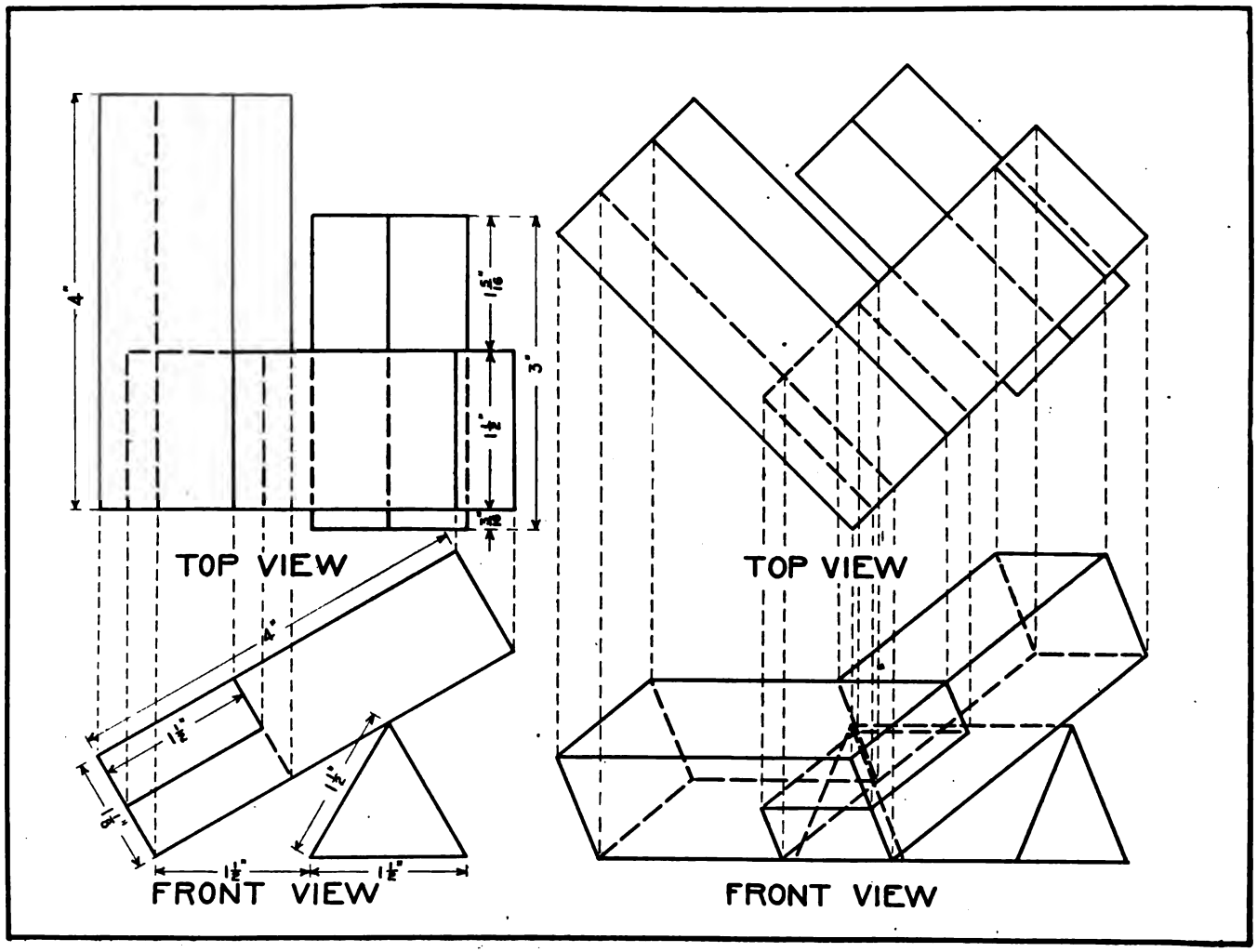


FRONT VIEW



FRONT VIEW

Plate 13A.


4"
1 5/16"
1 1/2"
3"
TOP VIEW
4"
1 1/2"
1 1/2"
1 1/2"
1 1/2"
1 1/2"
FRONT VIEW
TOP VIEW
FRONT VIEW

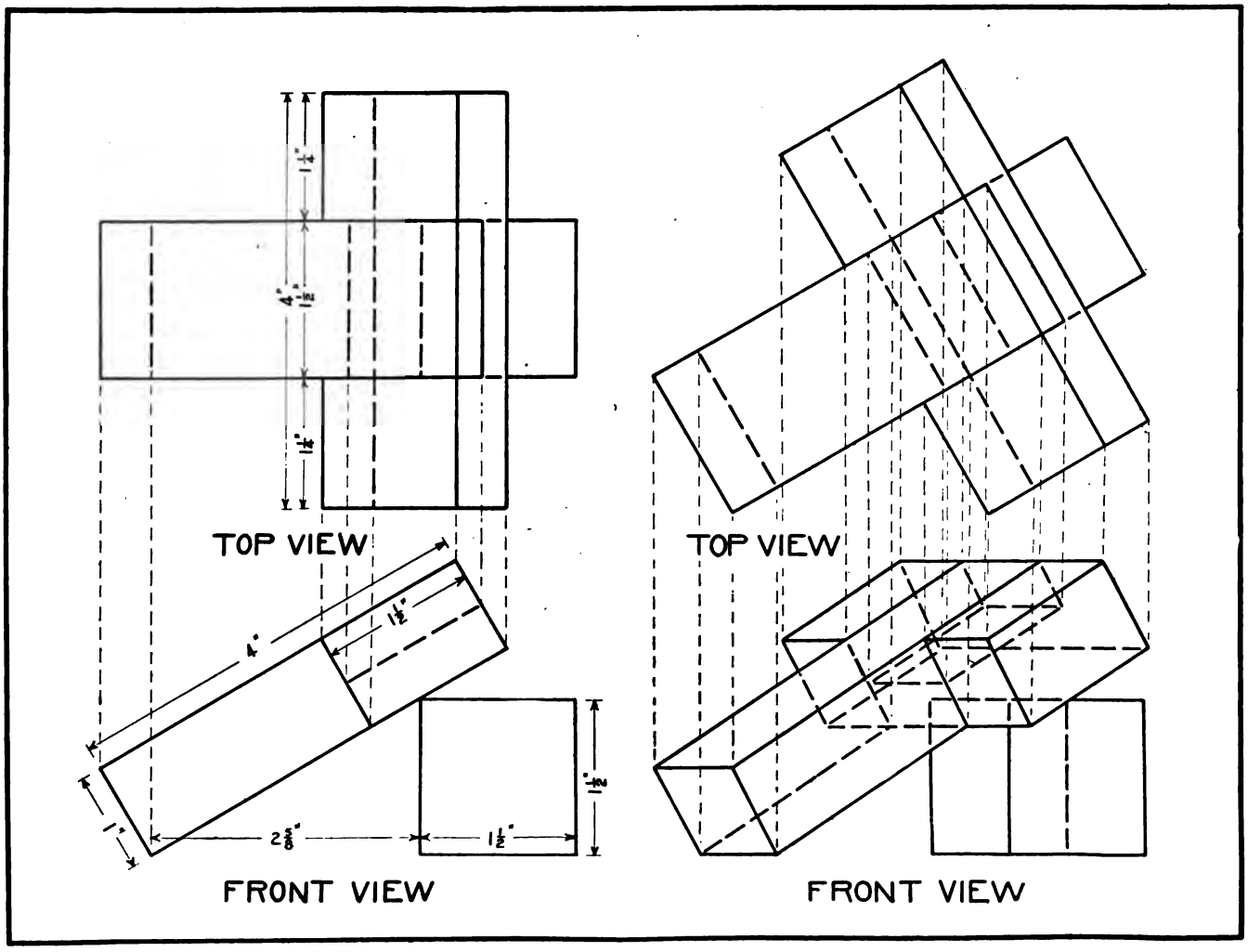
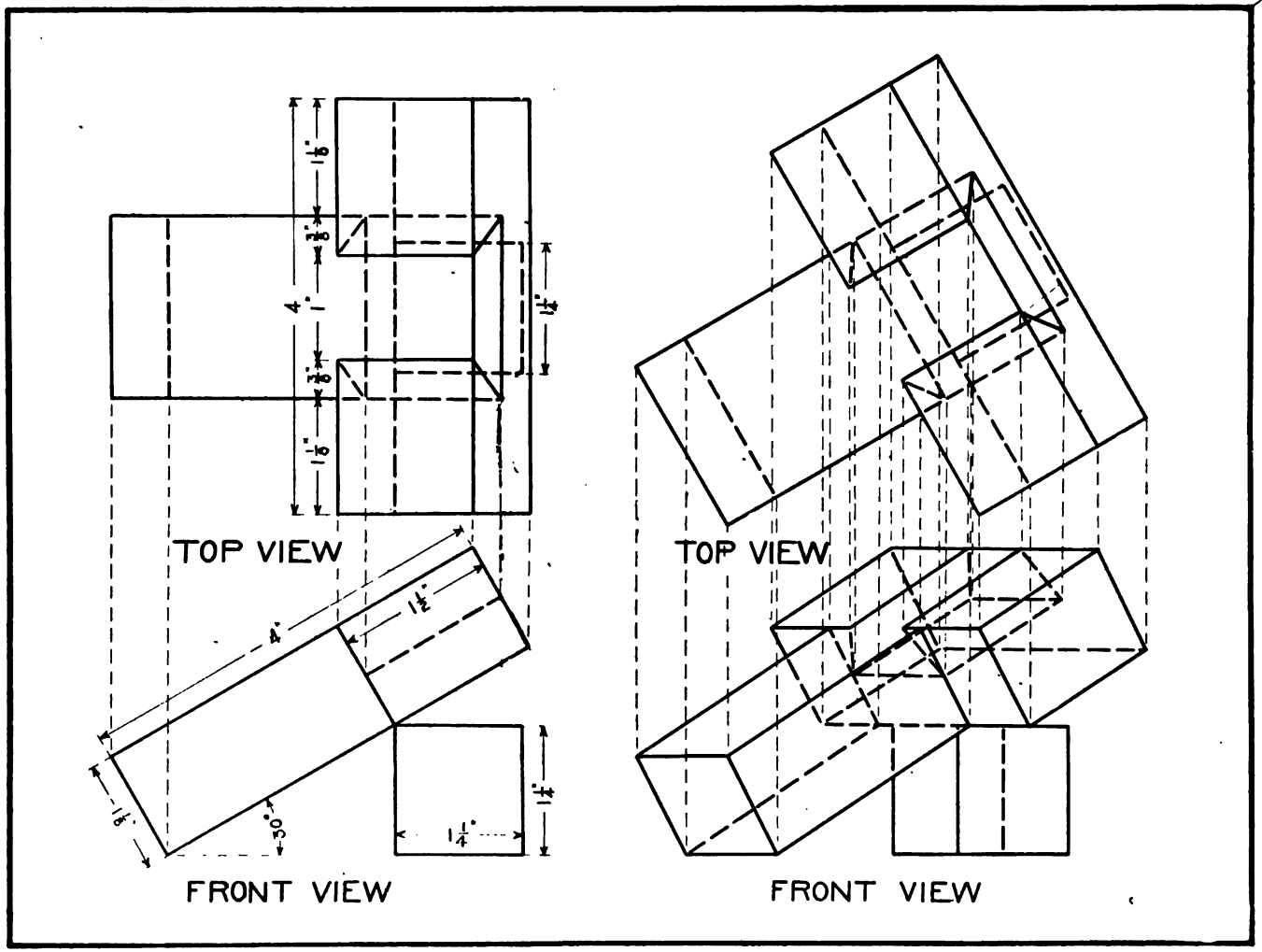

TOP VIEW
4"
1½"
1½"
4"
1½"
2⅝"
1½"
1½"
FRONT VIEW
TOP VIEW
FRONT VIEW

Plate 13C.


1½"
3"
1"
3"
1½"
4"
1½"
TOP VIEW
4"
1½"
1½"
30°
1¼"
1½"
FRONT VIEW
TOP VIEW
FRONT VIEW

WORKING DRAWING OF FOOT-REST

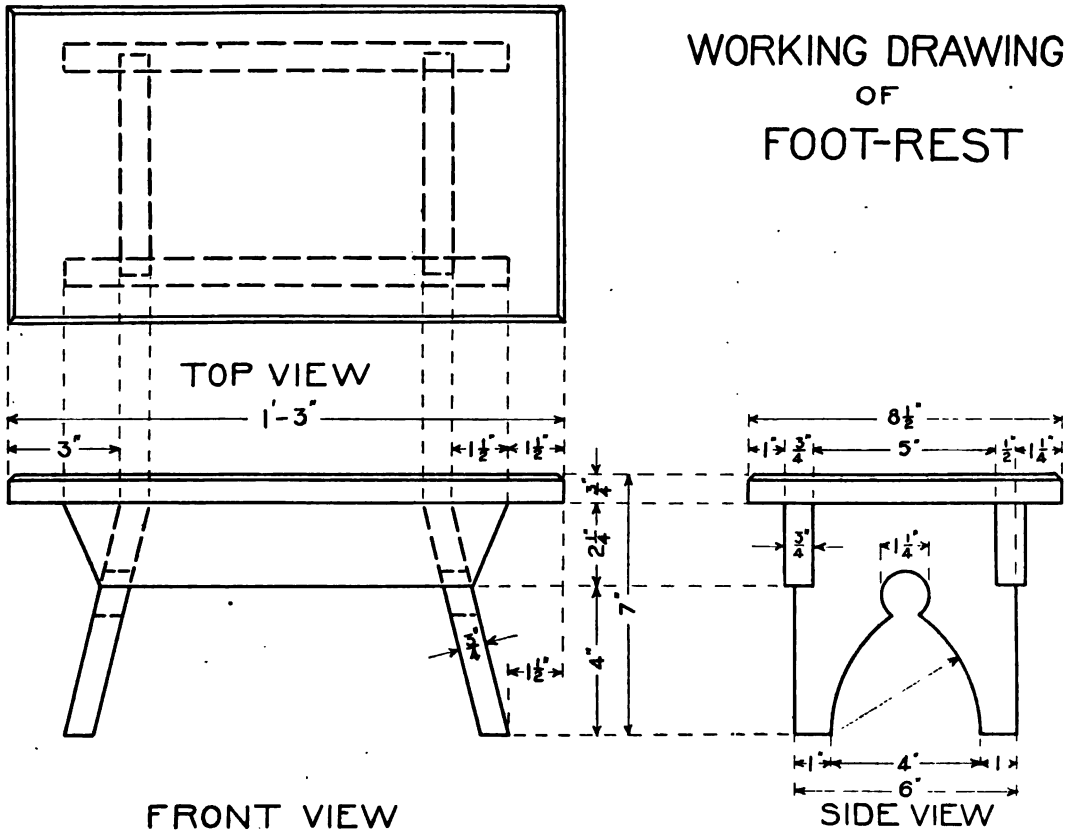
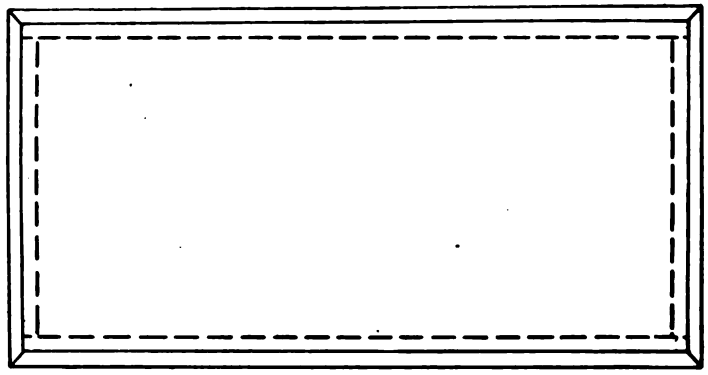
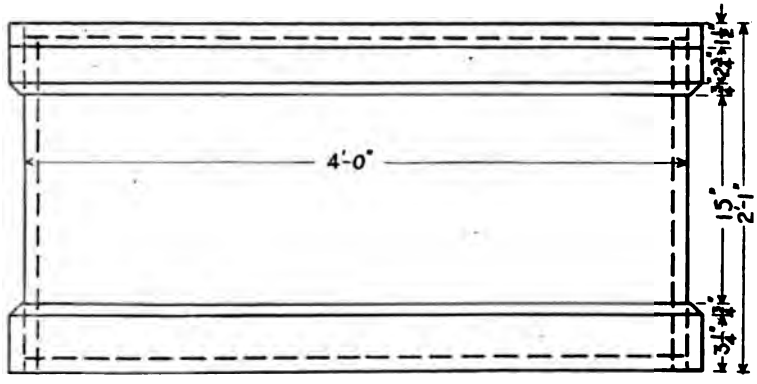


Plate 13E.

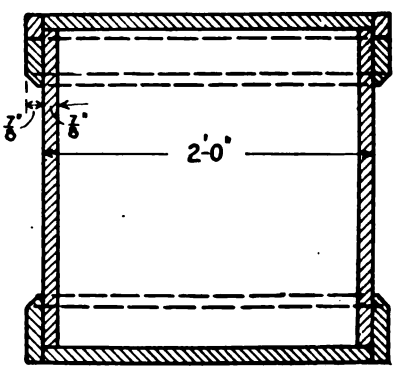
WORKING DRAWING OF CHEST



TOP VIEW

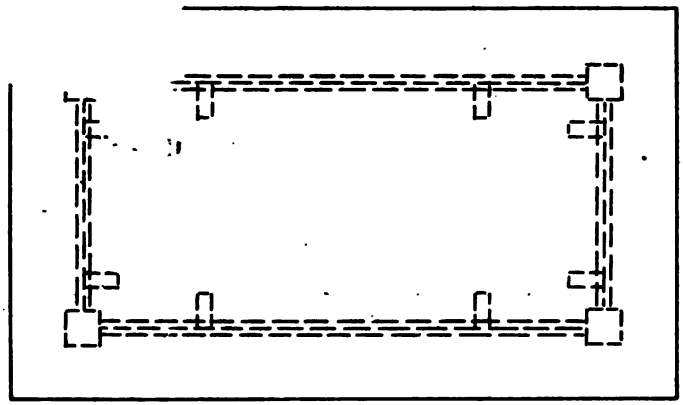


FRONT VIEW

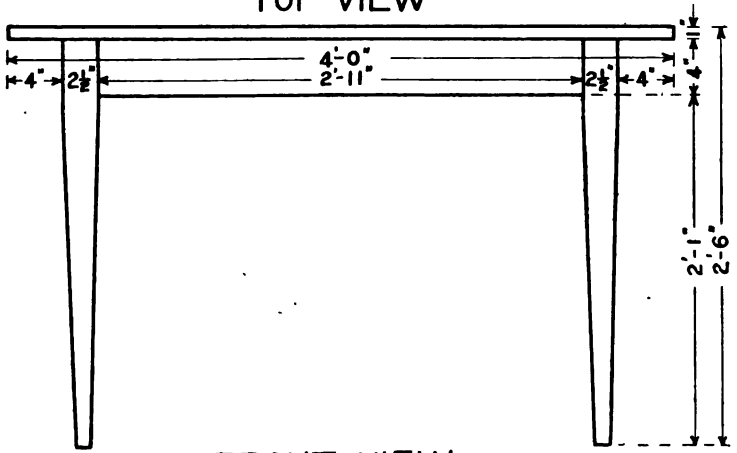


SECTION

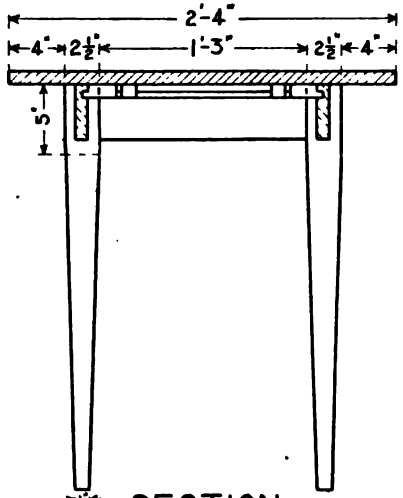
WORKING DRAWING OF TABLE



TOP VIEW



FRONT VIEW



SECTION

CHAPTER IV.

INTERSECTION OF SOLIDS AND DEVELOPMENT OF SURFACES.

The surface of an object is developed by laying out its several faces accurately upon a plane. If this drawing be cut out and folded where its several faces intersect, it will produce an object of the same shape and equal in size to the original. Any object based upon the cube, cylinder, or cone may be developed, but those based upon the sphere are non-developable.

Plate 14.—Draw the front and top views of the cube. Its pattern is found by unfolding or laying out its several faces. As the cube has six faces, we have simply to lay out six squares in some convenient form. Usually it is desirable to tint the pattern with some light wash of color. It gives the student practice in laying on flat washes and the effect of the plate is much improved.

Plate 14.

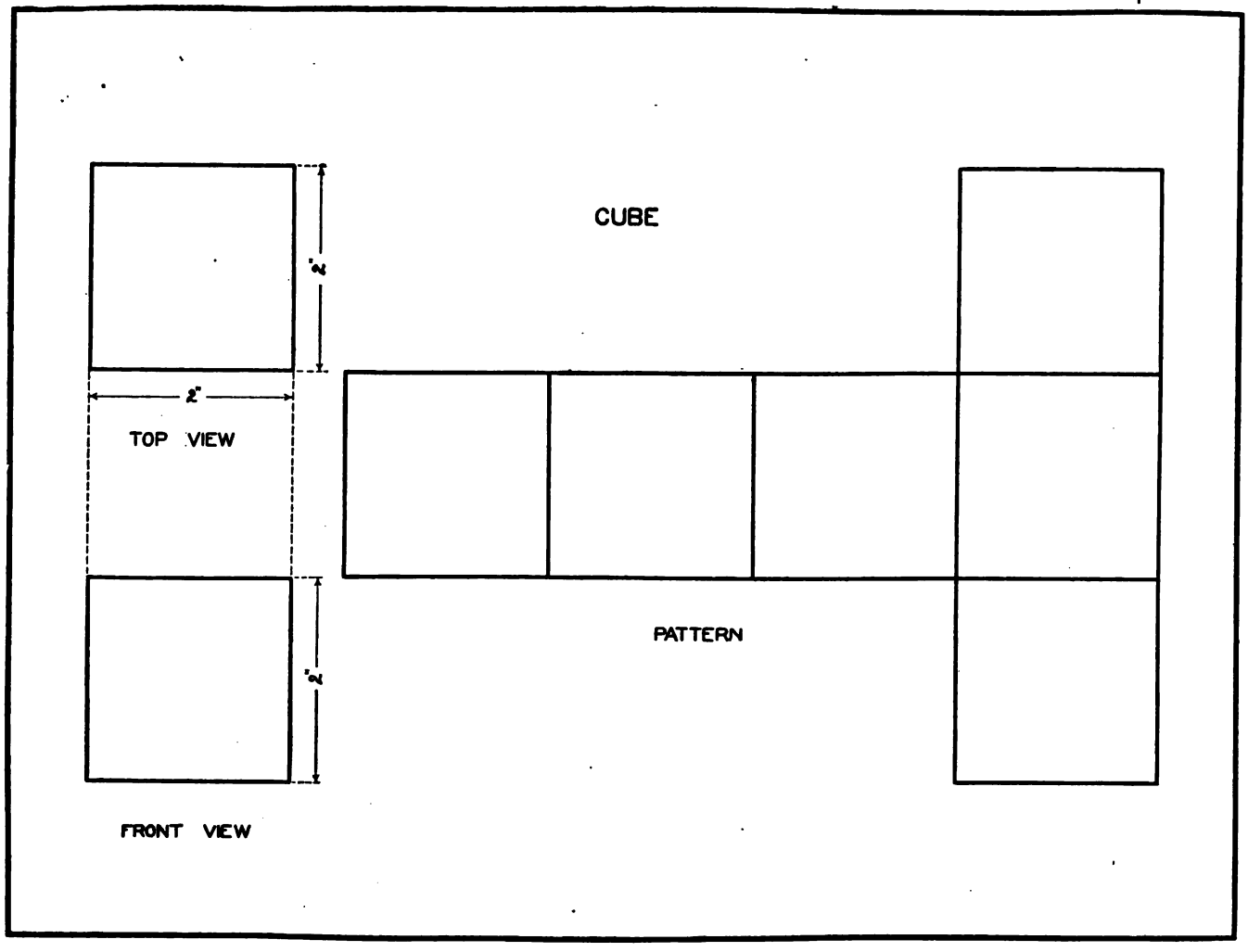


Plate 15.—The pattern of the cylinder is obtained by dividing the circumference into a certain number of equal parts, generally 12 or 24. The greater the number the more accurate will be the result, which is not absolutely correct, though near enough for all practical purposes, for we are measuring the chord each time instead of the arc. Having divided the circumference, say into 24 elements, take $\frac{1}{24}$ and step off 24 divisions on a horizontal line. The entire space upon this line will be equal to the circumference of the cylinder; and upon this line complete the rectangular figure, which will be equal in height to the length of the cylinder. The circles represented in the pattern are equal to the bases of the cylinder.

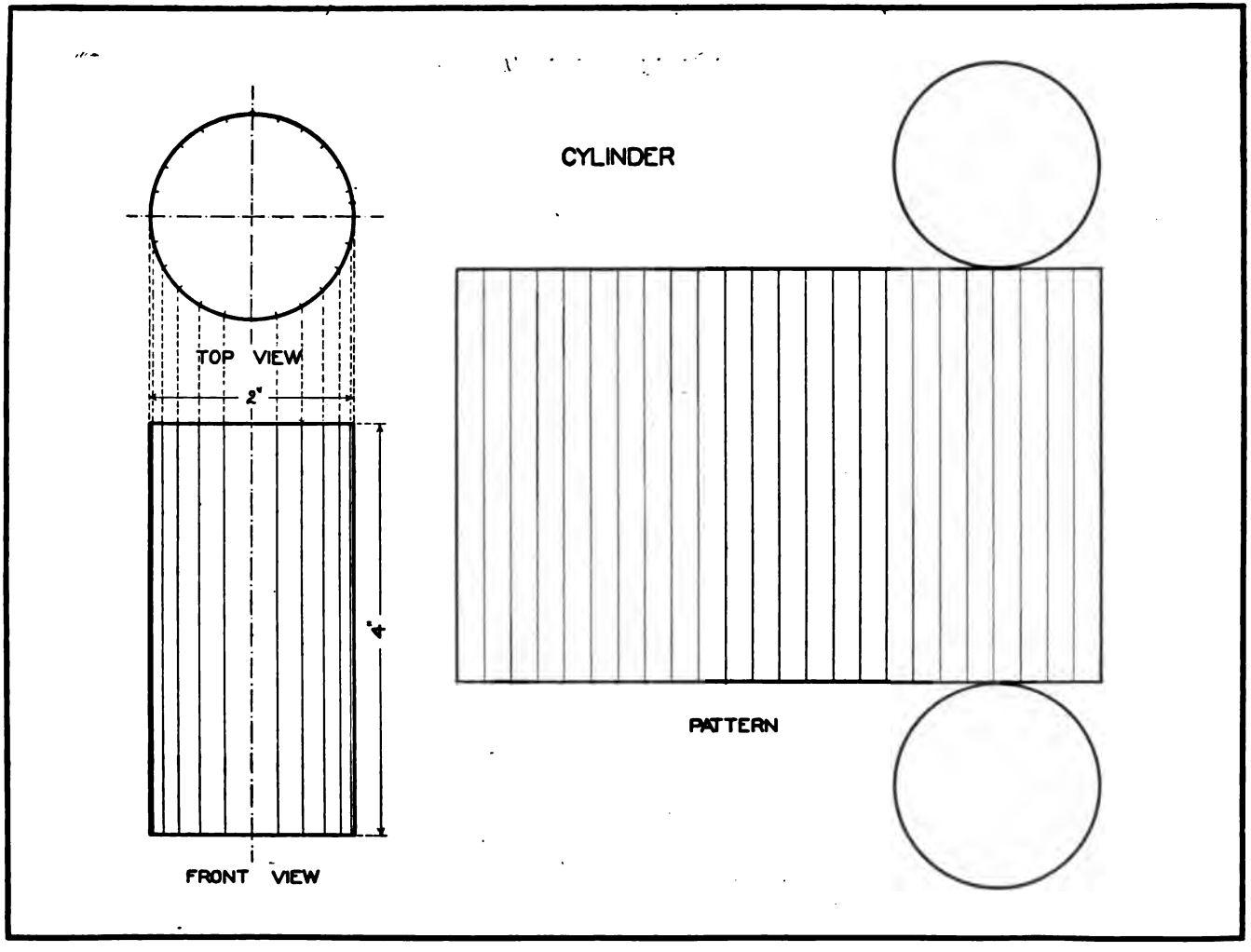
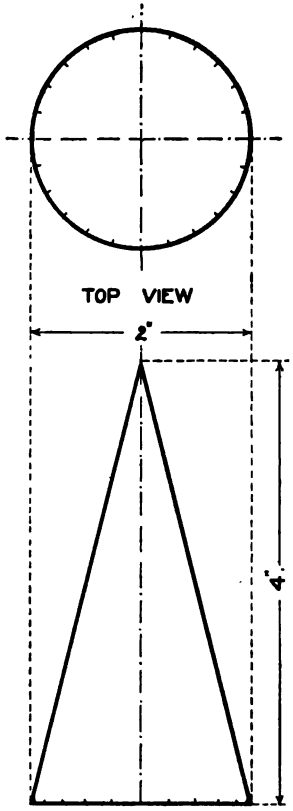

CYLINDER
TOP VIEW
2"
4"
FRONT VIEW
PATTERN

Plate 16.—The base of the cone is divided into a certain number of elements as was that of the cylinder. But instead of being rolled out upon a horizontal line, its elements will form an arc of a circle, the radius of which will be equal to the slant height of the cone. Locate a circle equal to the base of the cone at any point tangent to the great arc.

CONE



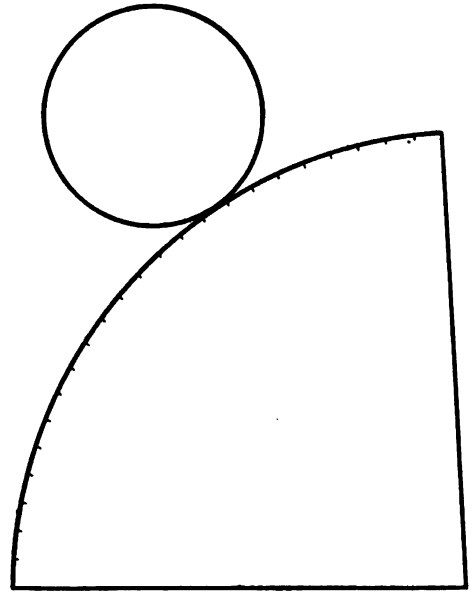
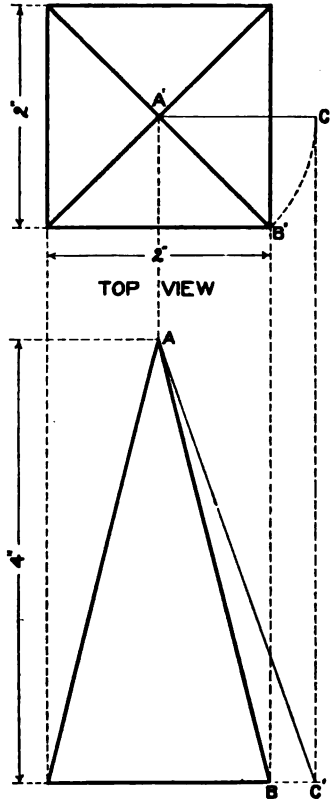


Plate 17.—The pattern of a square pyramid is made up of four triangles, equal in size to the faces of the pyramid, and a square equal to its base. The arc cutting the boundary lines of these triangles has for its radius the true length of one of the edges of the pyramid. This is found by revolving the line A B until it becomes parallel to the plane upon which the front view is supposed to be made. In the top view A′ C represents the revolved position of A′ B′, and if projected down to the front view will give us A C′, which is the true length of A B. Notice that only such lines as are parallel to the plane upon which the view is made can be measured their actual length.

SQUARE PYRAMID



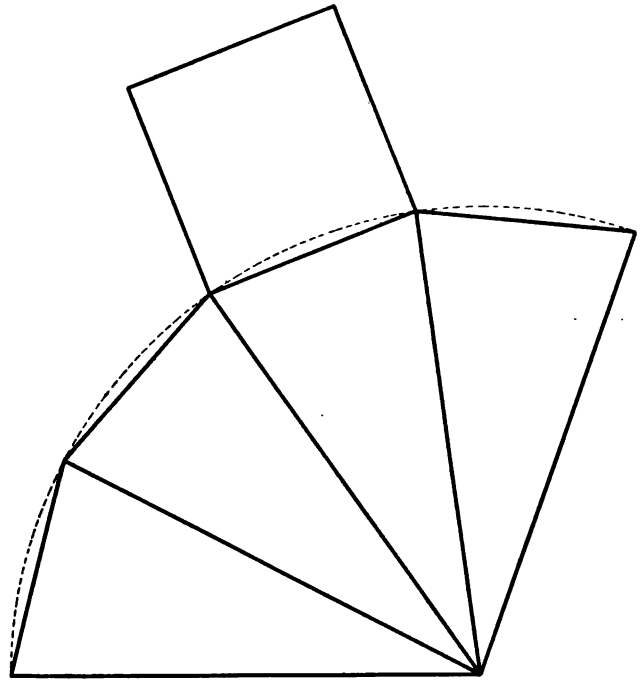


Plate 18.—Right elbow joint. In this plate we have the intersection of two cylinders, each being cut off at an angle of 45°, forming a miter joint. Each section should be developed separately. First develop or roll out the lower member as in the previous sheet, then measure the length of the elements in their proper sequence; and through the points obtained, pass a smooth line by the use of the French or irregular curve. The upper member is developed in a manner similar to the lower.

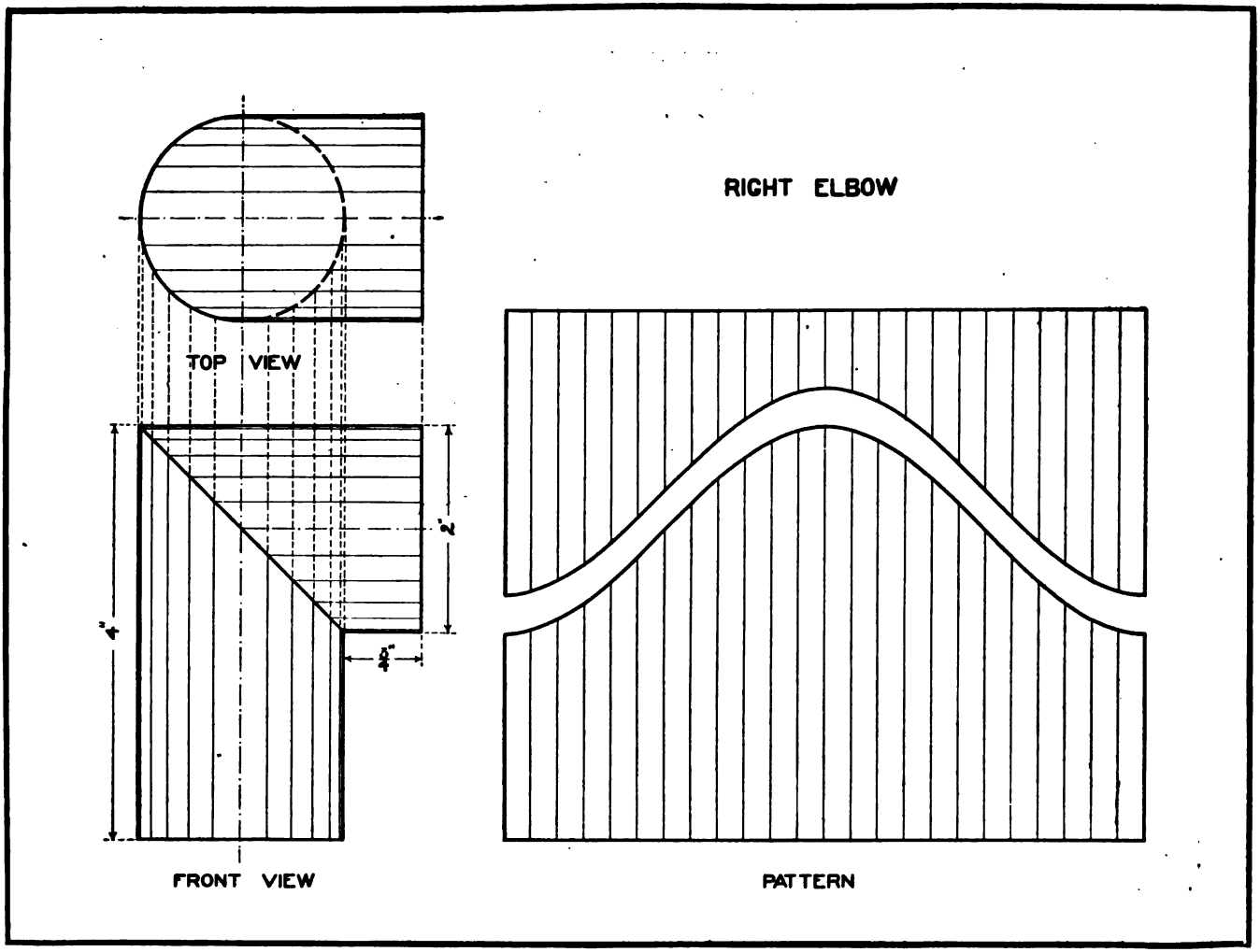
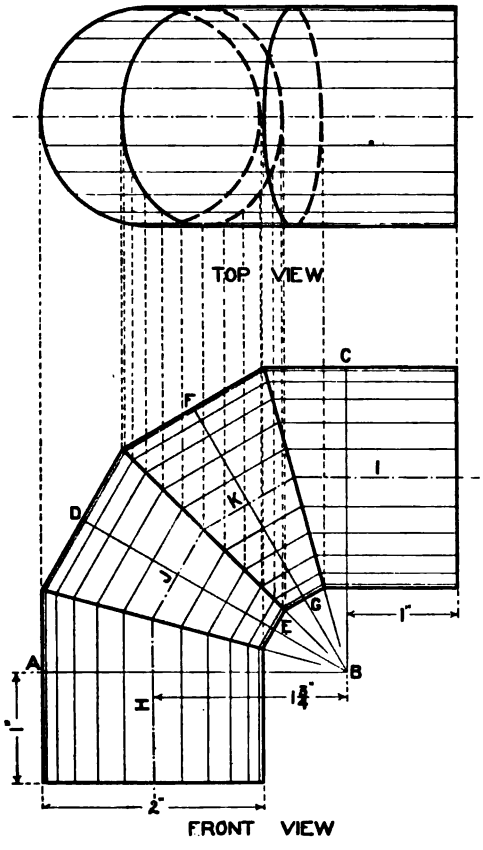

RIGHT ELBOW
TOP VIEW
4"
2"
2"
FRONT VIEW
PATTERN

Plate 19.—To find the intersection of the two pipes in the front view, divide angle A B C into six equal parts. Three of these divisions will form lines of intersection, two of which are seen as ellipses in the top view and may be found by projecting the several points in the front view caused by the intersection of the elements, to the corresponding elements in the top view. Members H and I are developed as in the foregoing sheet. Sections J and K should be laid out on center lines D′ E′ and F′ G′, which lines correspond to D E and F G; the elements being measured above and below the lines to correspond with each section.



FOUR PART ELBOW

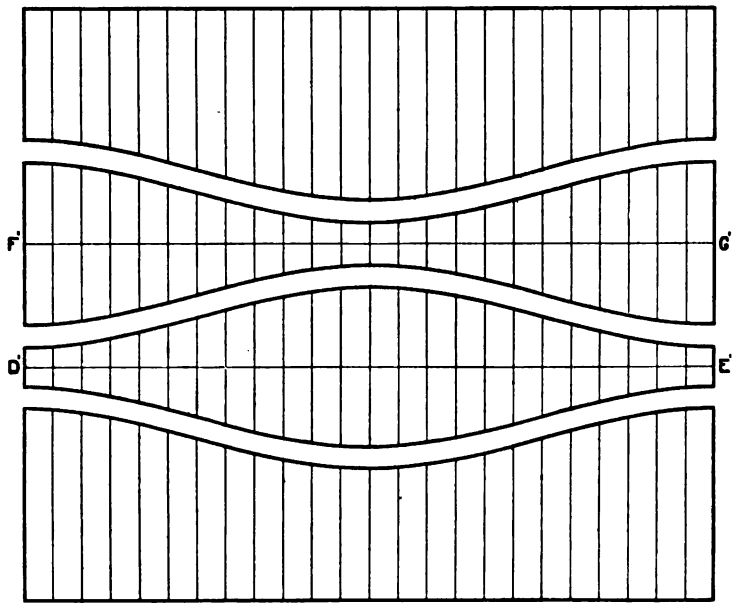


Plate 20.—The intersection of the horizontal pipe with the vertical is found by dividing the horizontal cylinder into 20 elements. Where the corresponding elements in the top view pierce the vertical cylinder, points are obtained which, projected down to the front view, will determine points through which to pass the curve caused by the intersection. The intersection of the oblique cylinder with the vertical is carried out in a similar manner. The three cylindrical pipes should be developed first as right cylinders, after which their elements measured, giving points through which to pass curves, as in the preceding plate. The opening for the horizontal pipe in the pattern of the vertical pipe may be found by laying off the elements 1′, 2′, 3′, 4′ and 5′, which correspond to 1, 2, 3, 4 and 5 in the top view. On these elements lay off their corresponding lengths as found in the front view. The opening in the center of the pattern is found in a similar manner.

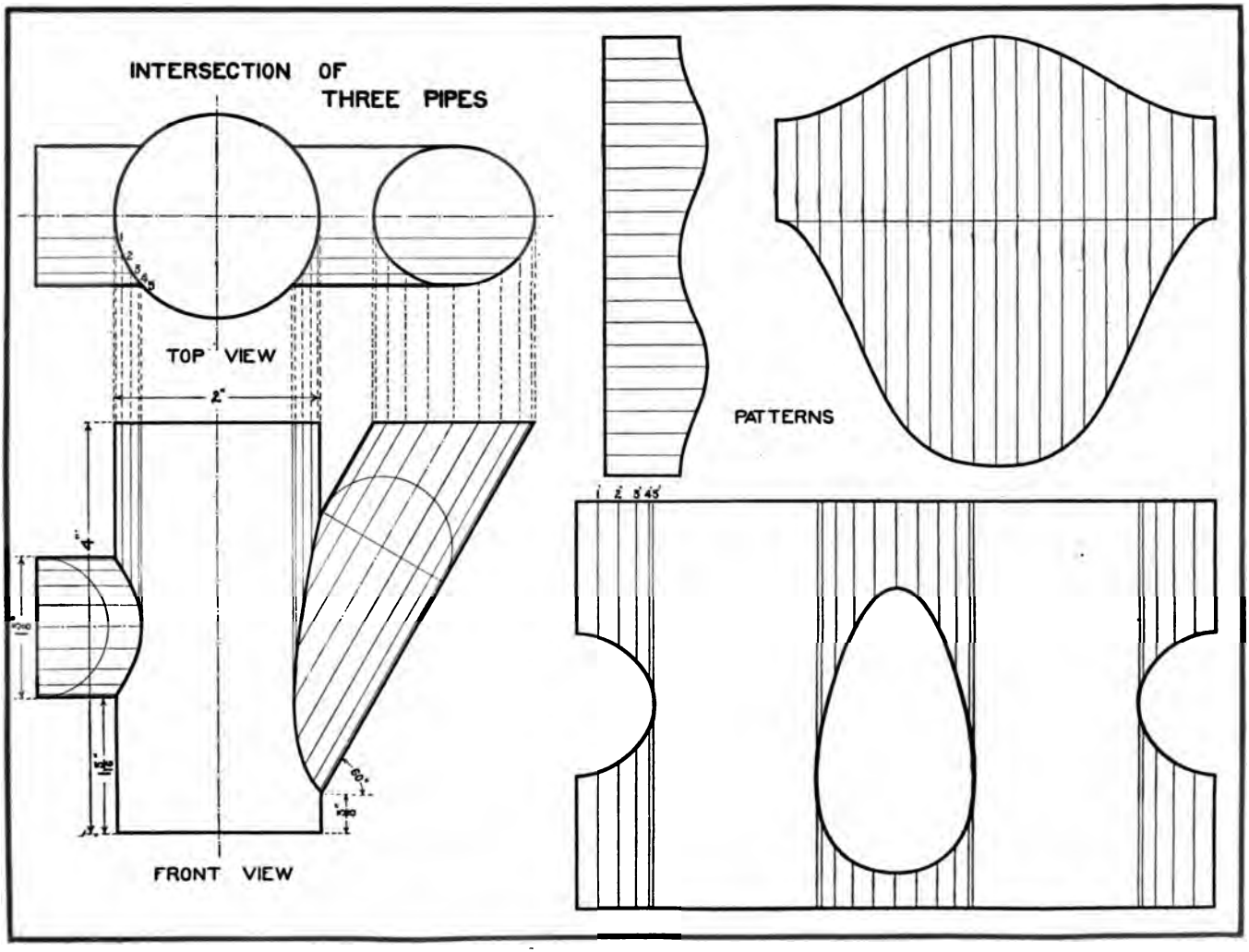

INTERSECTION OF
THREE PIPES
TOP VIEW
2"
FRONT VIEW
PATTERNS

Plate 21.—In this problem we have a hexagonal pyramid piercing a square prism; the hexagonal pyramid is drawn so it shows three faces in the front view, and the square prism is turned to present two equal faces.

The intersection of the hexagonal pyramid and the square prism in the front view may be determined by projecting points from the corresponding intersection in the top view. In finding the patterns. lay out both the square prism and hexagonal pyramid as though they had not been cut, then measure the various lines as in the preceding problems.

Plate 21.

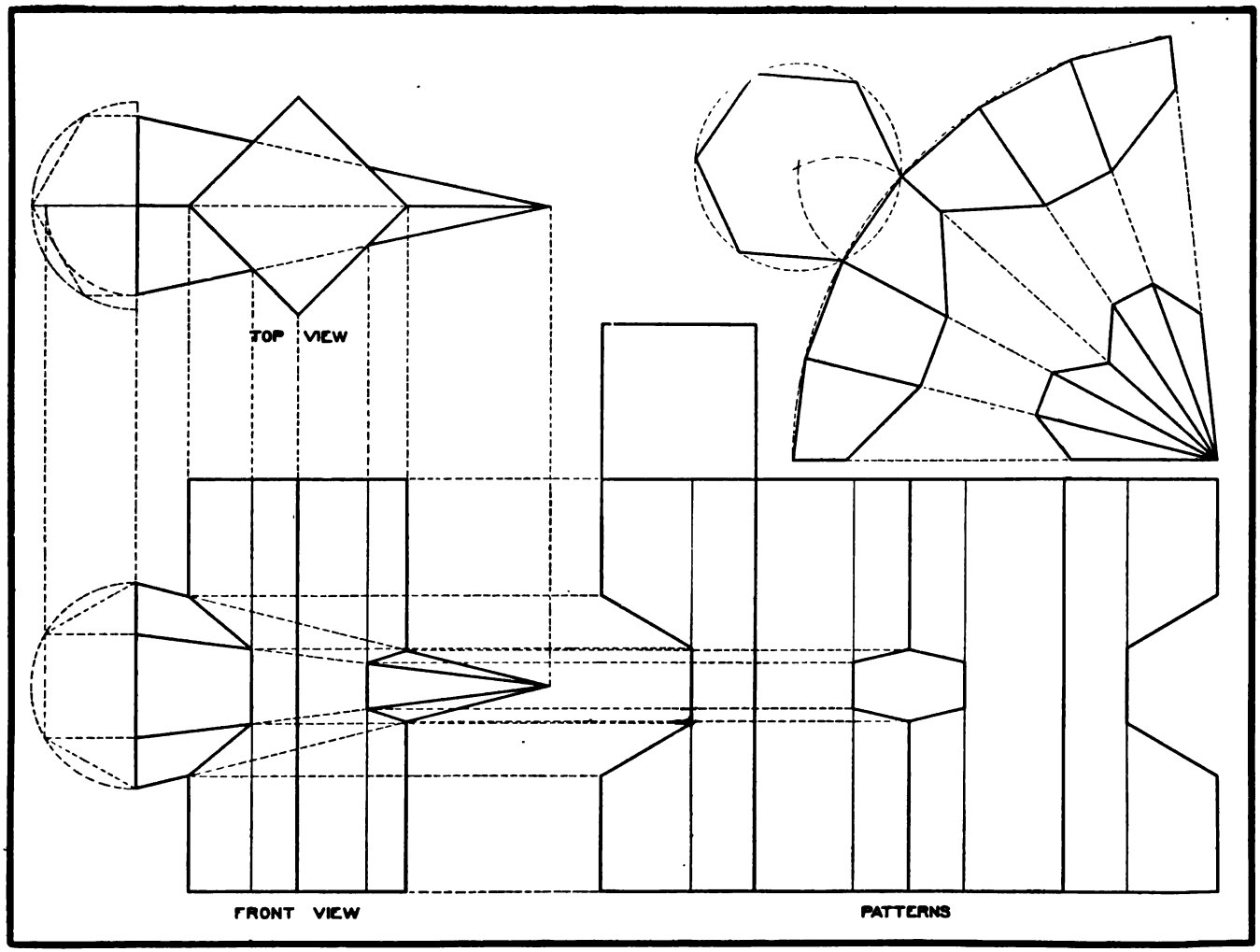


Plate 22.—To find the intersection of a square pyramid and a cylinder, the square pyramid being turned to show two equal faces in the front and top views, and the axes of the two solids intersecting.

Three points, as may be seen, are determined at once; but points 2′, 3′, 4′ and 5′, and other corresponding points are found by dividing the faces of the pyramid into a certain number of elements. Where these elements pierce the solid in the top view in 2, 3, 4 and 5, project down to corresponding elements in the front view, and so obtain 2′, 3′, 4′ and 5′. The pattern of the cylinder is found as in the previous problems. Points 2′″, 3′″, 4′″ and 5′″ in the pattern of the square pyramid are found as shown in point 5′″, in which the distance from 9′ to 8′ and 9′ to 8″ is equal to 9-8. Connect 8′ and 8″, cutting the corresponding elements, which gives 5′″.

Plate 22.

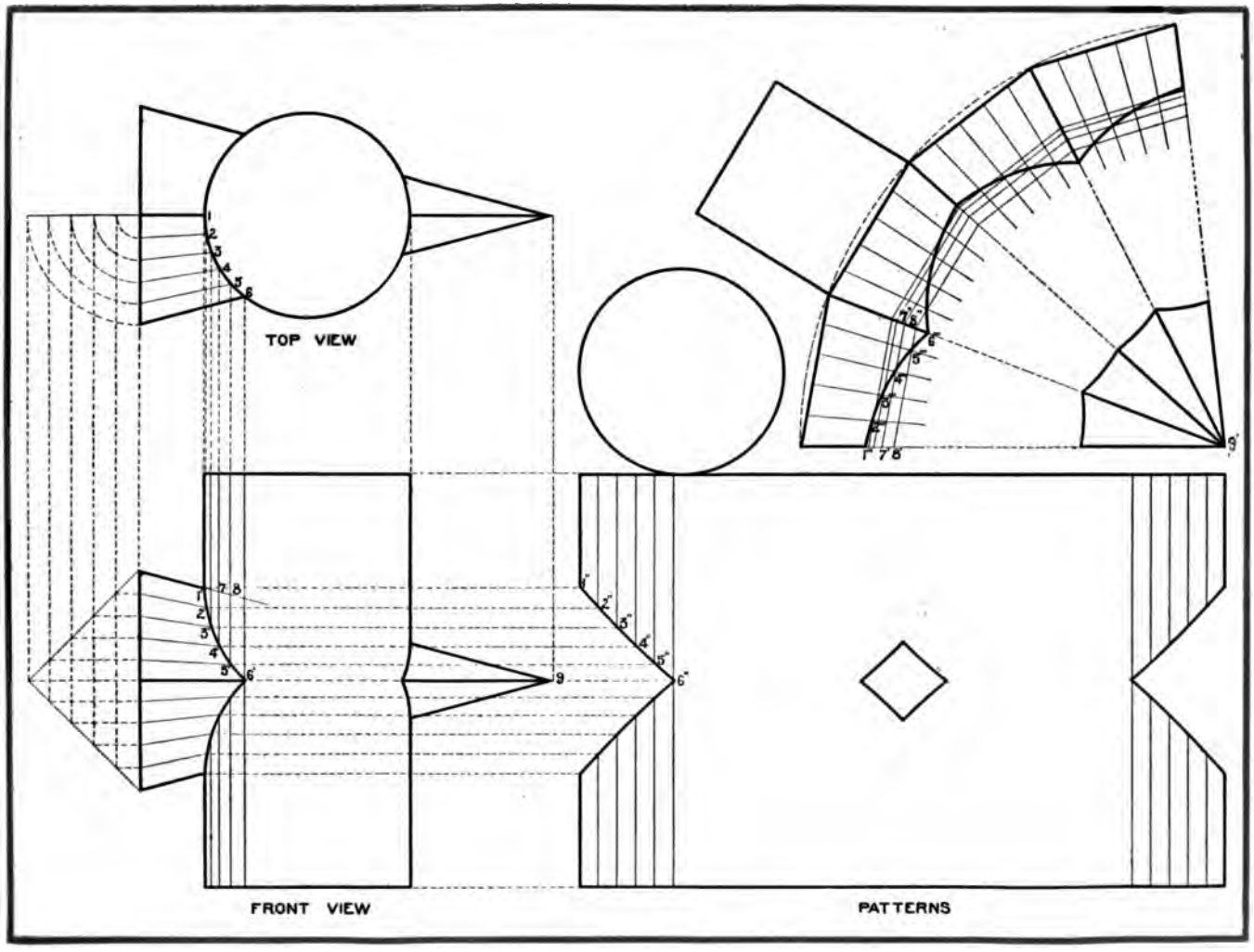
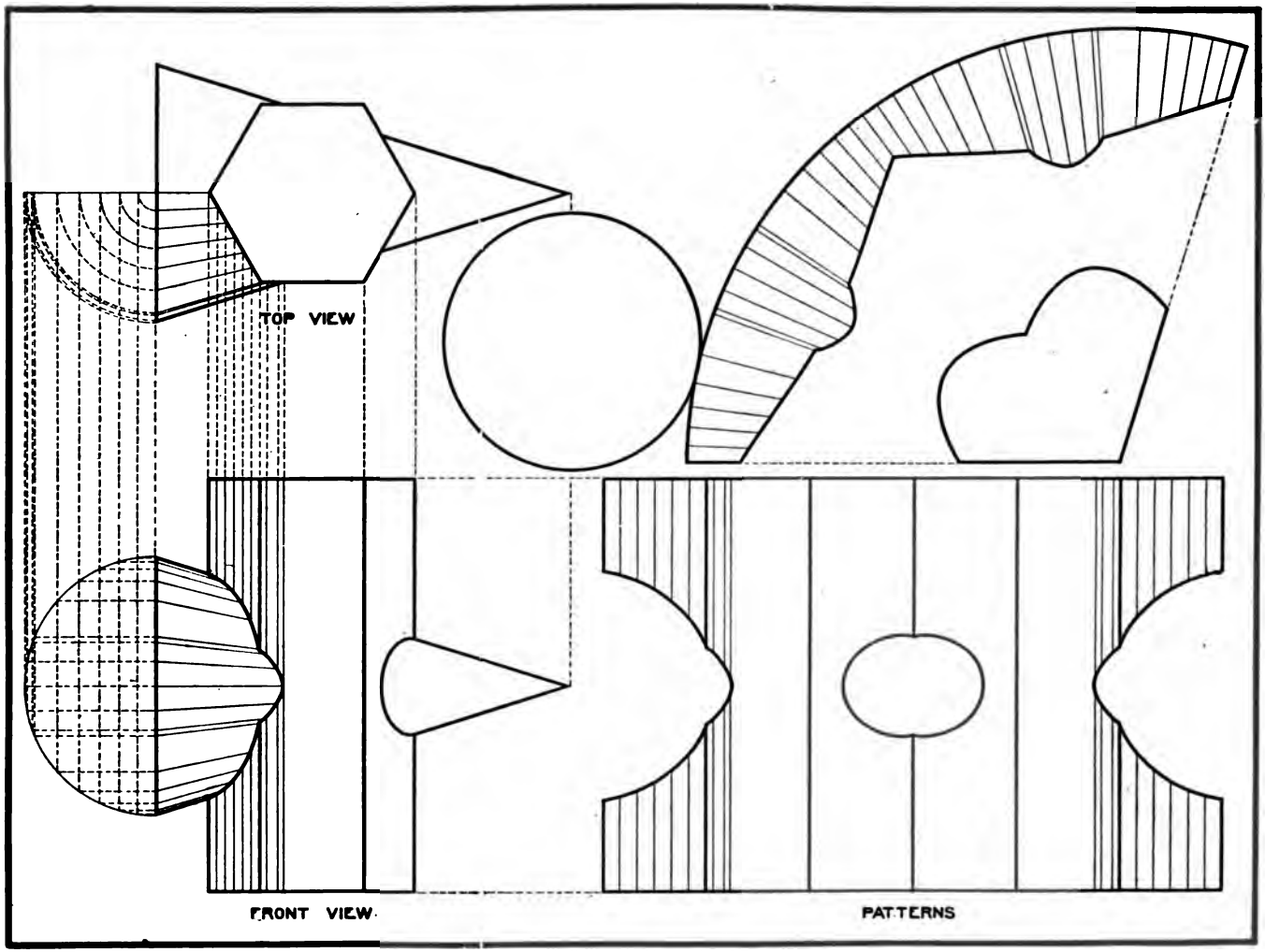


Plate 23.—This problem presents the intersection of a cone and a hexagonal prism. The principles differ little from those of the preceding plates. The student should not forget that the elements upon the cone should be measured on the outline, as has been explained.

Plate 23.



CHAPTER V.

PROJECTION OF SHADOWS.

The principal object of working out the shades and shadows upon a drawing is to reveal form which would otherwise appear flat. By the cast shadows upon the façade of a building one may readily determine the shapes of its various details, making the drawing far more comprehensive.

We consider the rays of light falling upon an object as direct, indirect, diffused, or artificial. Direct rays are those that fall directly on the object. Indirect rays are reflected back from some other object. Diffused light is that reflected from innumerable surfaces. Artificial light is sometimes used in interior perspective, but never in projection of shadows.

The high light of an object is that portion which receives the rays direct. Shade on an object is due to the interception of the sun's rays by its own form. It varies in intensity, being darker at the dividing lines of light and shade, since the side directly opposite the light receives more reflected light. Shadow on any surface is due to the absolute cutting off of direct rays by some object. The shape of the shadow will be determined by the character of the receiving surface, and the form of the object casting the shadow. Shadows are never black, but should be darker than the shade; the reason being that the shadow does not receive as much reflected light as the shade. Shadows are always cast upon surfaces that would otherwise be in the direct light, never upon a surface that is in the shade, or one that is already in shadow.

When two surfaces join, one being lighter than the other, the contrast at the point of intersection is exaggerated; that is, the light appears by contrast lighter than it really is, while the dark appears darker. In drawing the roof of a building against the sky the upper portion of the roof is made darker by its contrast with the bright sky. Windows and doors are usually drawn darker in the upper portion, as the lower is supposed to receive more reflected light. If there is a door within a door the treatment is reversed; that is, the upper part is made lighter than the lower, giving contrast and transparency.

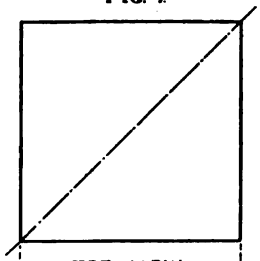
Plate 24.—In working out the shades and shadows of an object, we consider the rays of light as coming downward parallel to a line drawn through the diagonal of a cube. Fig. 1 shows the cube and the diagonal drawn in three positions. The diagonal appears to make an angle of 45° with the horizontal plane in the front view, and an angle of 45° with the vertical plane in both the top and side views. The student will observe that the rays of light do not appear at their true angle. That may be found, as illustrated in Fig. 2, by drawing the cube in a position which will place the diagonal parallel to the vertical plane.

Another method of finding the true angle of the sun's rays with the horizontal plane is given in Fig. 3, in which we have the front and top views of a line representing a ray of light. Revolve line A′ B′ until it is parallel to the vertical plane. Point A will appear in the front view to move in a horizontal line and will be found directly under point A″. Connecting A′″ with B gives the true angle of the sun's rays with the horizontal plane.

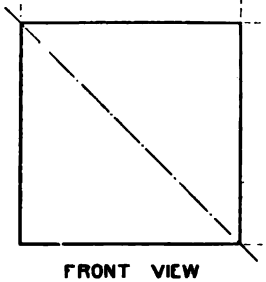
In Fig. 4 we have the front and top views of a vertical line casting a vertical line of shadow upon a vertical plane. If a line is parallel to the plane receiving the shadow, the shadow will be parallel to the line casting it and have the same length. To obtain the position of the shadow, draw a line at 45° from point A′, intersecting the vertical plane in C. Let fall a vertical line from C until intersected by line at 45° from A and B, giving line D E, which is the shadow cast by line A B.

Fig. 5.—This problem is similar to that in Fig. 4. It is given to show that a side view may be used instead of the top view, as in many cases will be found more convenient. The student will see that the results are precisely the same.

FIG. 1.

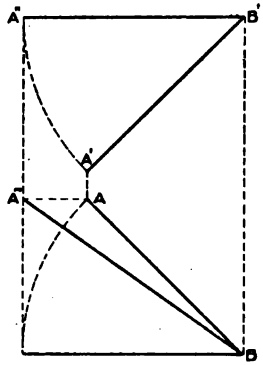


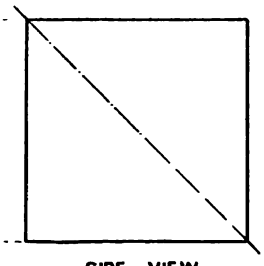
TOP VIEW



FRONT VIEW

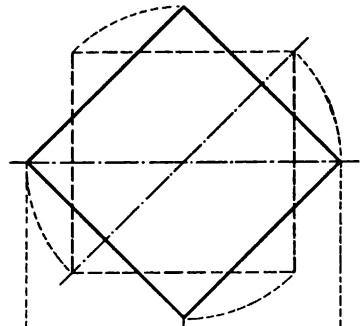
FIG. 3.



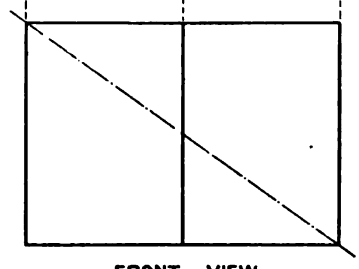


SIDE VIEW

FIG. 2

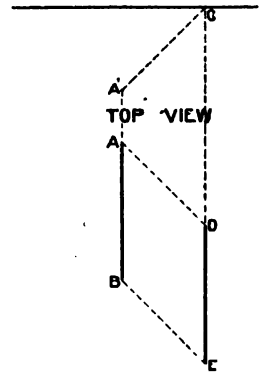


TOP VIEW



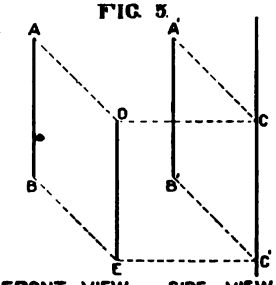
FRONT VIEW

FIG. 4.



FRONT VIEW

FIG. 5.



FRONT VIEW SIDE VIEW

Plate 25.—In Fig. 1 we have the front and side views of a square plane casting a shadow upon a vertical surface to which it is parallel. A line parallel to the surface receiving the shadow will always cast a line of shadow parallel to itself, therefore the outlines of this shadow must be parallel to the outlines of the plane which casts it. The various points in the side view of the square plane may be projected at 45° to the vertical plane and then carried over to obtain corresponding points on lines projected downward at 45° in the front view.

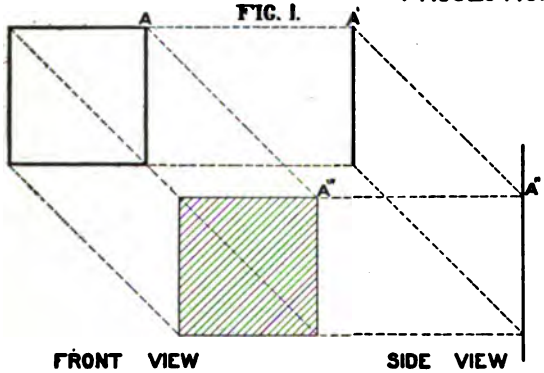
Fig. 2.—To cast a shadow of a vertical plane that is perpendicular to the vertical plane upon which the shadow is to be cast. As the two vertical lines are parallel with the vertical plane which receives the shadow, they must produce vertical lines of shadow. A horizontal line that is perpendicular to the vertical plane will always cast a line of shadow at 45°, no matter what the character of the surface may be, nor where the shadow falls; therefore, the two horizontal lines which are perpendicular to the vertical plane will cast shadows at an angle of 45°. The shadow may be completed as in the last problem.

Fig. 3.—To draw the shadow of a horizontal plane that is perpendicular to the vertical plane upon which the shadow is to be cast. Two of the horizontal lines are parallel with the vertical plane upon which the shadow is to be cast, therefore they will cast horizontal lines of shadow. Two of the horizontal lines are perpendicular to the vertical plane upon which the shadow is to be cast, and their lines of shadow will be at 45°.

Fig. 4.—To find the shadow cast by a cube upon the vertical plane. This problem is a union of the last three figures; that is, if all the points were found the shadow would be divided into three sections: section A, corresponding to the shadow in Fig. 1, section B to that in Fig. 2, section C to that in Fig. 3. No new principle is introduced; the problem is simply made a little more difficult by uniting the several surfaces and forming a cube.

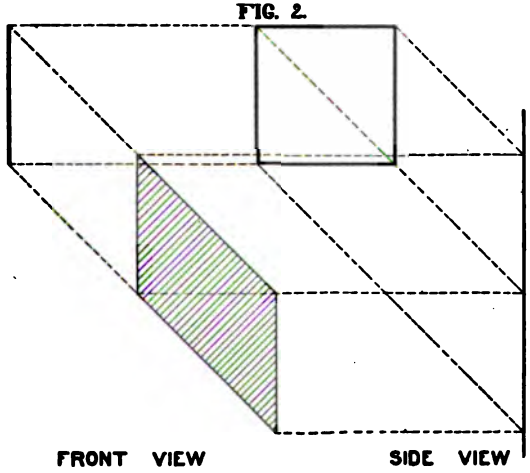
PROJECTION of SHADOWS

FIG. 1.



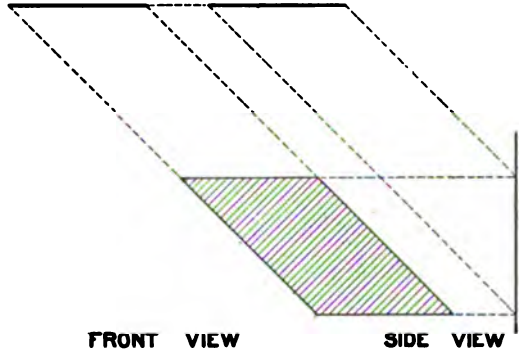
FRONT VIEW SIDE VIEW

FIG. 2.



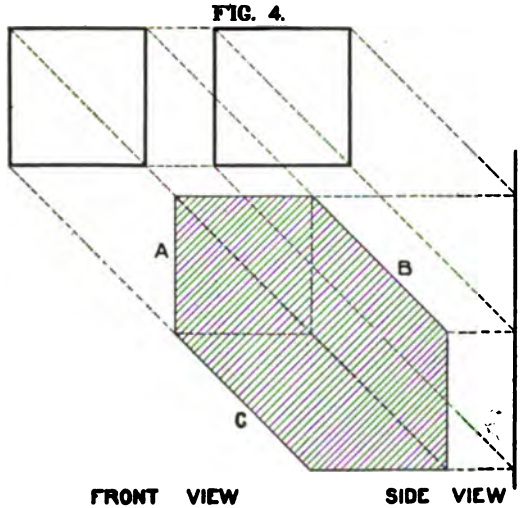
FRONT VIEW SIDE VIEW

FIG. 3.



FRONT VIEW SIDE VIEW

FIG. 4.



FRONT VIEW SIDE VIEW

Plate 26. Fig. 1.—To cast the shadow of an octagonal plane that is parallel to the vertical plane upon which the shadow is to be cast. As all of the lines of this figure are parallel to the vertical plane, their lines of shadow will be parallel to themselves as worked out in the drawings.

Fig. 2.—To cast the shadow of a vertical octagonal plane that is perpendicular to the vertical plane upon which the shadow is to be cast. This is best done by finding the separate points and connecting them as shown in the drawing.

Fig. 3.—To cast the shadow of a horizontal octagonal plane upon a vertical plane. This problem is worked in the same manner as that of Fig. 2.

Fig. 4.—To cast a shadow of a circular plane that is perpendicular to the vertical plane upon which the shadow is to be cast. Circumscribe the circle by an octagon and find the shadow of the octagon as in Fig. 3. Having found its outline, draw an ellipse which shall be tangent to the various lines of the octagon at their centers.

PROJECTION of SHADOWS

FIG. 1.

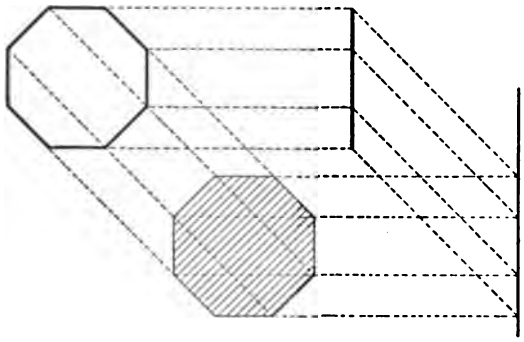


FIG. 3.

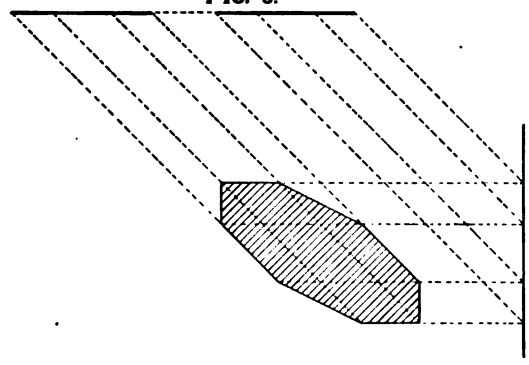


FIG. 2.

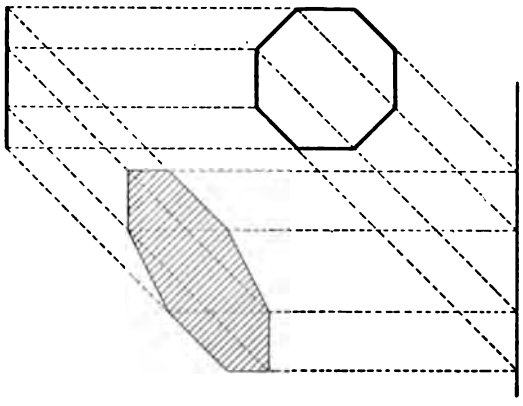


FIG. 4.

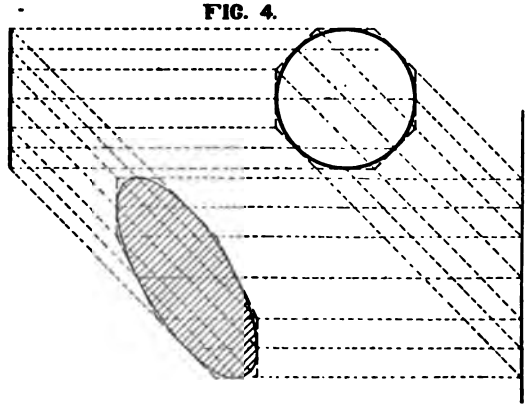
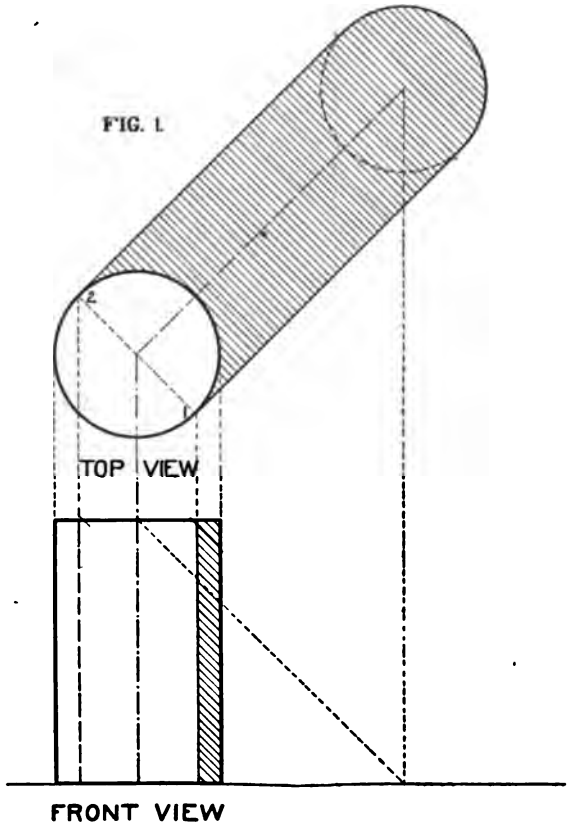


Plate 27. Fig. 1.—To cast the shadow of a vertical cylinder on a horizontal plane. The top surface of the cylinder is parallel to the horizontal plane, therefore its shadow will be parallel to itself and take the form of a circle. Find the shadow of the center of this circular surface, and on this center draw a circle equal to the diameter of the cylinder. Draw lines at angles of 45° tangent to the top view, which will meet and be tangent to the circle already found. Project points 1 and 2 downward upon the front view, which will determine the dividing lines of light and shade.

Fig. 2.—To cast the shadow of a vertical cone upon a horizontal plane. Find the shadow of the apex, and from this point draw lines tangent to the base of the cone. Lines drawn from the points of tangency to the apex in both the top and front views will be the dividing lines of light and shade.

PROJECTION OF SHADOWS



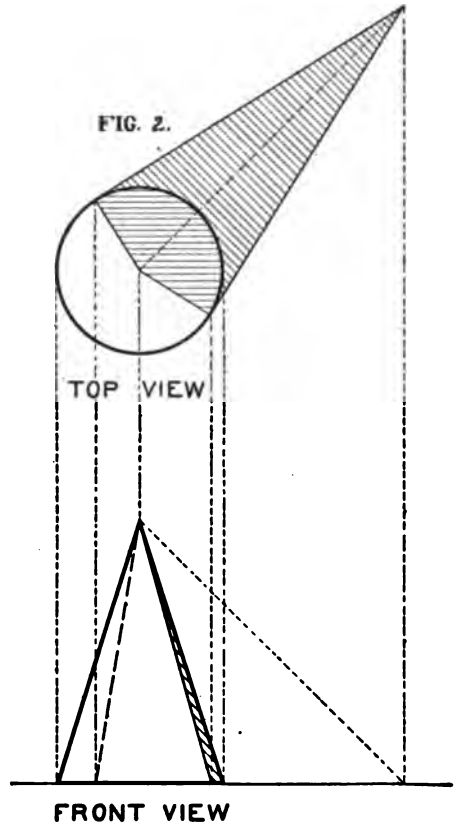


Plate 28. Fig. 1.—We have given two vertical cones, casting a shadow upon a horizontal plane. These cones are joined at their apexes and their elements make angles of 45° with their bases. First find the shadow of the base of the inverted cone and then the shadow of the point of intersection of their apexes, which will be point 1. From point 1 draw lines tangent to the base of the cone and to the circular shadow already obtained. It will be seen that just one-quarter of the inverted cone is in the light and three-quarters are in the shade, while in the upright cone it is the reverse, three-quarters in light and one-quarter in shade.

Fig. 2.—This problem differs from the preceding one in that the elements of the cones make angles of 35° 16′ (true angles of ray of light) with their bases, instead of 45°; but the working of the problem is precisely the same. It should be noticed that the elements of the inverted cone are wholly in the shade, while those of the lower cone are in the light; this is due to the fact that the elements A-B and B-C are parallel with the rays of light.

PROJECTION OF SHADOWS

FIG. 1.

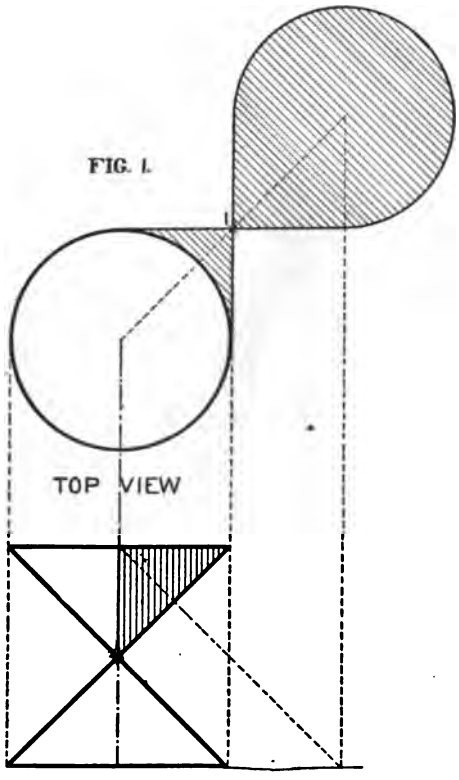


FIG. 2.

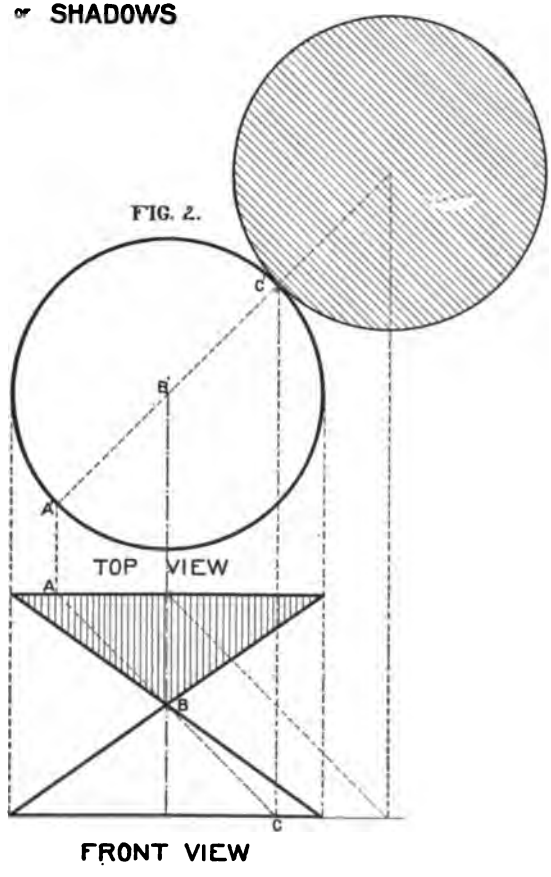


Plate 29. Fig. 1.—We have a sphere suspended, casting a shadow partly upon a vertical plane shown in the front view, and partly on the horizontal plane shown in the top view. It is evident that a portion of the sphere will be in the light and a portion in the shade. This dividing line of light and shade in both views will appear as ellipses equal in size. The diagram in Fig. 2 is given to show the method of finding this dividing line of light and shade. First draw the diameters 1-2 and 3-4 at 45°, 1-2 being the long diameter of the ellipse. Point 5 is the lowest point in the ellipse. To obtain this point, first draw a line tangent to the contour of the sphere at any angle of 35° 16′, which line is the true angle of a ray of light. This line becomes tangent at point 6 and intersects the axis in 7. From 7 take back a line at 45°, intersecting a horizontal line from point 6 in 5, which revolves the ray of light back to its position as the diagonal of the cube. Project point 5 up to meet the diameter 3-4 in 8. Lay off 9-10 equal to 9-8. With 8-10 as the short diameter and 1-2 as the long, construct the ellipse by means of a paper trammel. Ordinarily this diagram would be worked directly upon the problem. The shadow of the sphere upon the horizontal and vertical planes is found by first determining the shadow of the centers C and C′. Through these centers draw the short diameters 1–2 and 1′–2′, equal in length to the diameter of the sphere. 1–2 and 1′–2′ are bases of equilateral triangles which determine the lengths of the long diameters. Having obtained the long and short diameters, construct the ellipses with a paper trammel.

PROJECTION of SHADOWS

FIG. 1.

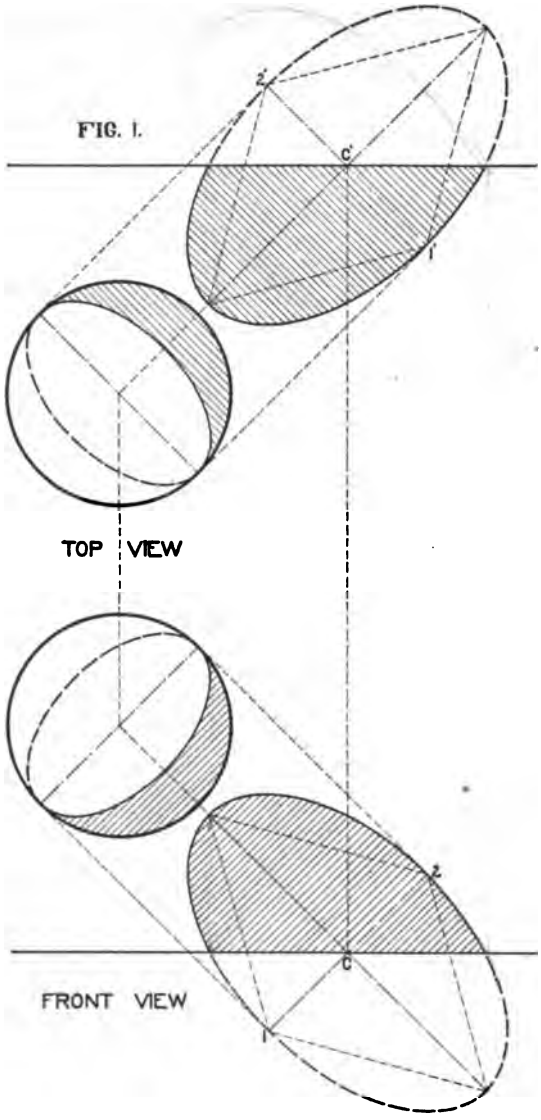


FIG. 2.

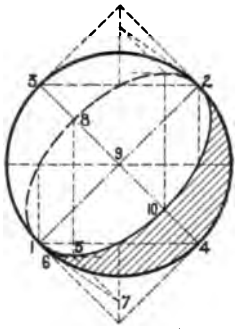
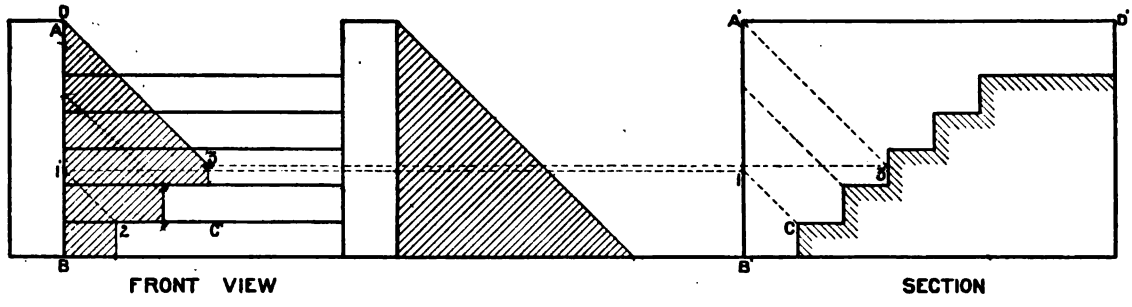


Plate 30. Fig. 1.—Cast the shadow of a horizontal abutment upon a flight of steps, also upon a vertical plane. The shadow is more readily obtained by the use of a section, or side view, as it thus becomes a very simple matter to determine where the lines cross various angles of the tread and risers. To determine the position of a shadow cast by line A B upon the first riser, take a line back at 45° from angle C, intersect the line A B in 1, and carry this point over to the front view, giving the point 1′, from which draw a line at 45°, cutting the edge C′ in point 2. The line casting the shadow is parallel to the receiving surface, therefore this shadow will be parallel to A B or a vertical line drawn through 2. The shadow of the vertical line A B terminates in point 3. As the horizontal line A D is perpendicular to the vertical plane, its shadow must be at an angle of 45°.

Fig. 2.—Cast the shadow of a slanting abutment upon a flight of steps, also upon a vertical plane. This problem is slightly more difficult than the preceding one, but the principles are precisely the same and the student should have no difficulty in working it, having completed Fig. 1.

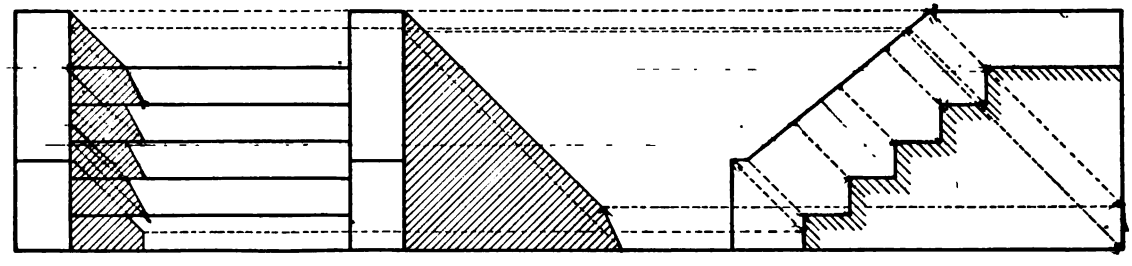
PROJECTION of SHADOWS

FIG. 1



FRONT VIEW SECTION

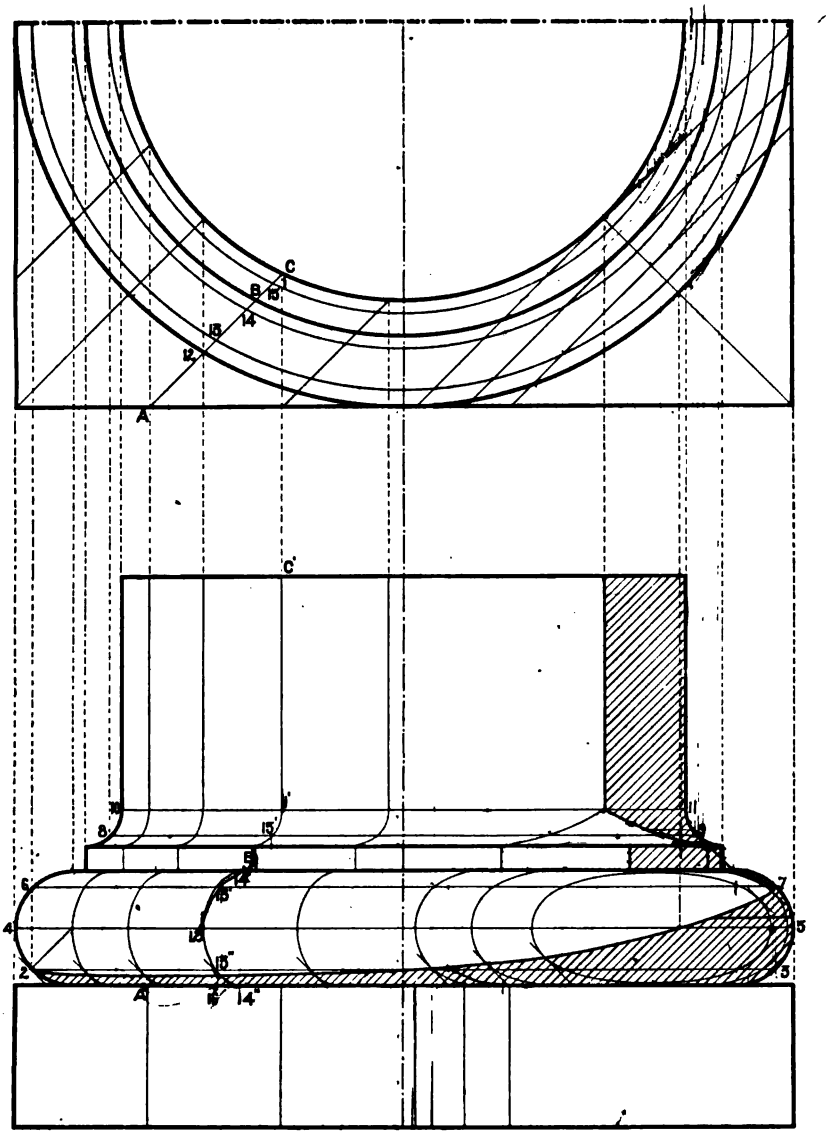
FIG. 2.



FRONT VIEW SECTION

Plate 31.—We have the top and front views of a Tuscan base, upon which to find the dividing line of light and shade. In this drawing it is found by what is known as the slicing method. That is, several vertical slices are taken at various points (it is immaterial where), which appear as straight lines in the top view and somewhat resemble the contour of the base in the front view. A B C of top view, and A′ B′ C′ in the front view, represent one of these cutting planes. The curved lines from 14″ to B′ and from B′ to 1′ are found by using horizontal planes 2-3, 4-5, 6-7, 8-9 and 10-11, which appear as straight lines in the front view, but as semicircles in the top view. Points 12, 13, 14 and 15, projected from the top view down to the corresponding traces in the front view, will give points 12′, 13′, 13″, 14′, 14″ and 15′, through which to draw a curve made by the cutting plane. As this plane is parallel to the rays of light, the last ray falling upon the torus is found by drawing a line at 45° tangent to the section. This gives us point 16, through which the dividing line of light and shade will pass. The other points are found in the same manner.

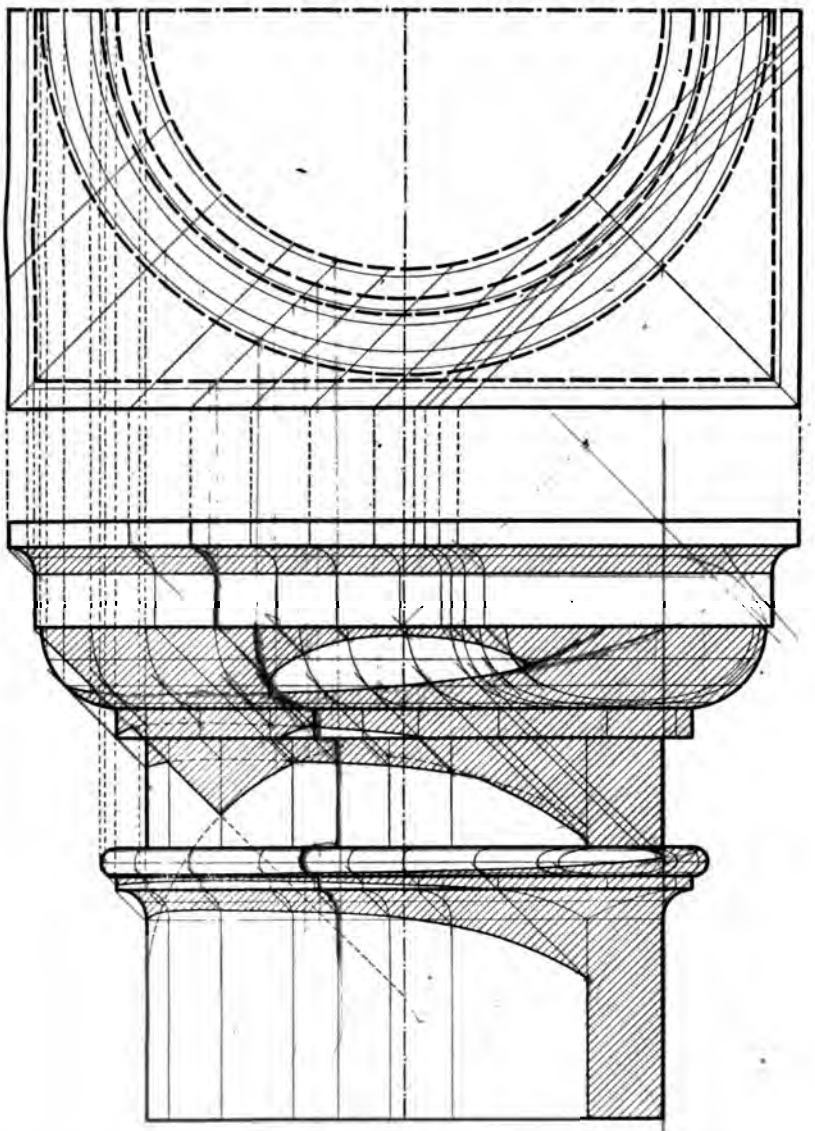
PROJECTION OF SHADOWS



TUSCAN BASE

Plate 32.—Find the shades and shadows on a Tuscan capital. The shadows are found in this as in the previous plate; the student who has completed that should have little trouble in performing this problem.

PROJECTION OF SHADOWS



TUSCAN CAPITAL

Plate 33.—This plate is given especially to show that the shadow of any object may be worked directly upon the front view without the use of a top view, provided that the draughtsman knows how far the lines lie in front of the vertical plane receiving the shadow. In Figs. 1, 3 and 5, the shadows are cast by the use of the front and top views; in Figs. 2, 4 and 6, the objects are identically the same, the top view being omitted.

Fig. 2.—To cast a shadow of a rectangular body upon a vertical plane. Point 2 is found by first making the distance A 1 equal to A B in Fig. 1, after which let fall from 1 a vertical line, and from A draw a line at 45°, cutting it in 2. Points 3 and 4 are found in a similar manner, as shown in this drawing.

Fig. 4.—Cast the shadow of one-half of a hexagonal plinth upon the vertical plane. Point 2 is found by making distance A 1 equal to A B in Fig. 3; from 1 let fall a vertical line and from A a line at 45°, intersecting in 2. Points 3 and 4 are found in a like manner.

Fig. 6.—We have a rectangular body casting a shadow partly upon a molded surface and partly upon a vertical plane. It will be noted that the outline of a shadow on a molded surface cast by a horizontal line parallel to the vertical plane is a curve identical to its section. Having found point 1 by the method given in the two previous problems, it becomes a very simple matter to complete the outlines of the various members of the molding.

PROJECTION or SHADOWS

FIG. 1.

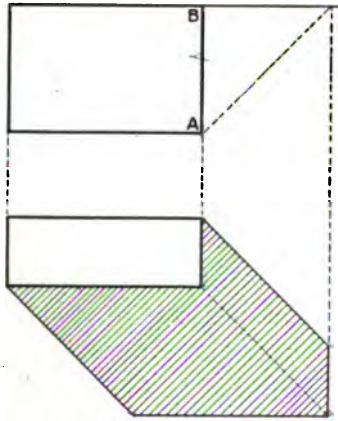


FIG. 3.

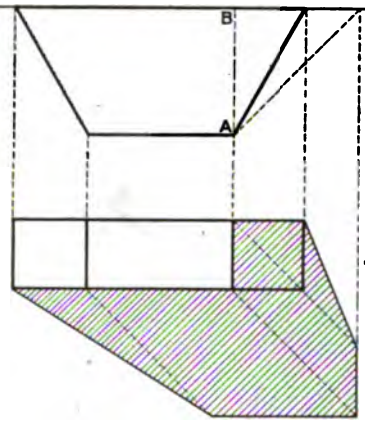


FIG. 5.

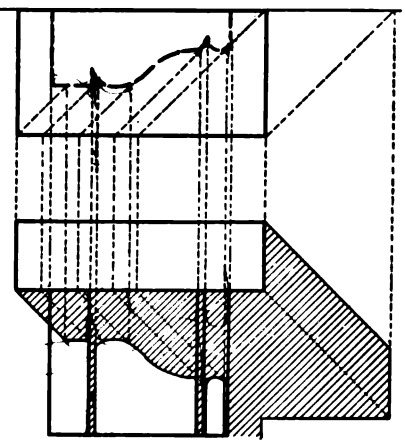


FIG. 2.

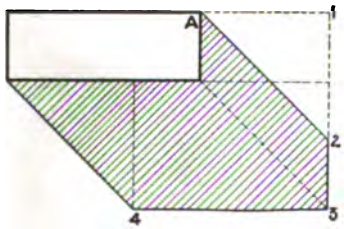


FIG. 4.

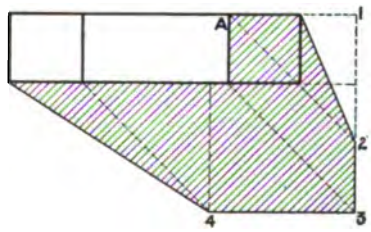


FIG. 6.

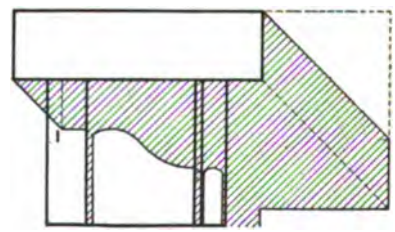


Plate 34. Fig. 1.—This plate illustrates the method of casting the shadow of a chimney upon the roof of a building. The student should notice that vertical lines cast lines of shadow parallel to the angles of the roof on which they are thrown. Horizontal lines that are parallel to the oblique plane cast horizontal lines of shadow, and horizontal lines that are at right angles to the vertical plane cast lines of shadow at 45°.

Fig. 2.—The principles in this problem are carried out as in Fig. 1. The beam A projects the distance 1-2 beyond the surface of the building. Point 3′ is found by letting fall an imaginary vertical line to intersect the edge of the roof in 4. Line 4-3′ is parallel with the angle of the roof, which line is cut by a 45° line from 3.

Fig. 3.—The shadow cast in the niche is found by the slicing method, as described and carried out in Plate 31.

PROJECTION of SHADOWS

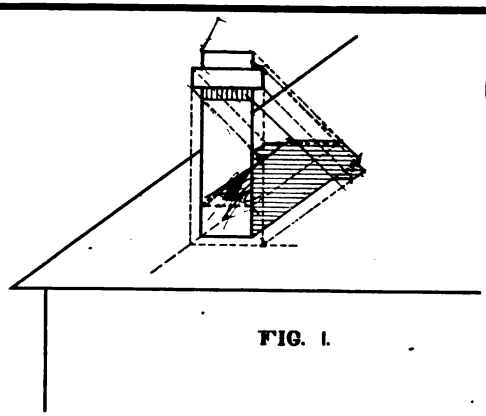


FIG. 1.

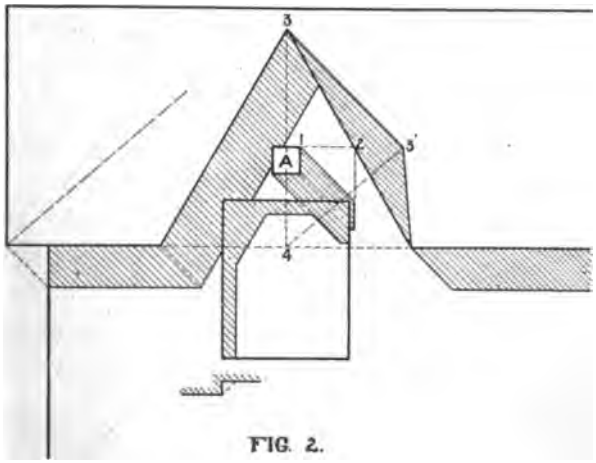
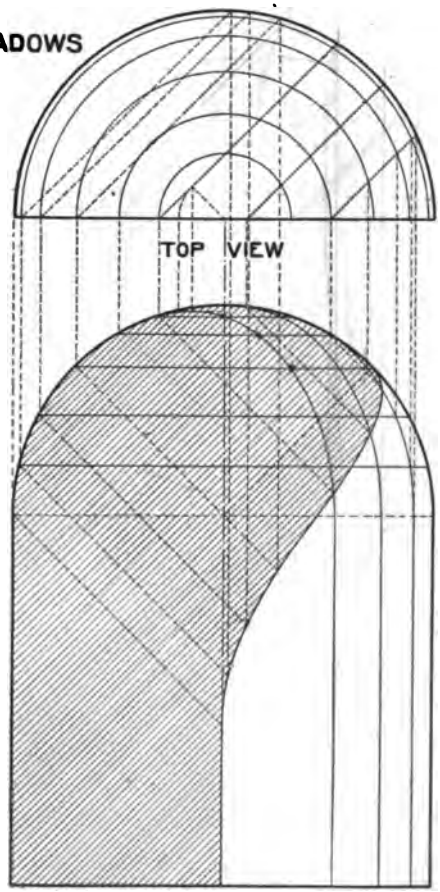


FIG. 2.



FRONT VIEW
FIG. 3

Plate 35. Fig. 1.—The shadow cast by the line A B of the plinth upon the cylinder may be found by drawing lines from A and B at 45°, intersecting in 1, and with 1 as center and 1-2 as radius describing an arc cutting the 45° lines in 3 and 4. Let drop a vertical line, 4-5, which will be the dividing line of the light and shade of the cylinder. Shadow line A 3 is cast by a horizontal line which is perpendicular to the vertical plane, and, as we have noted before, such a line always casts a shadow at 45°. The arc 3-4 is really part of an ellipse, but is foreshortened exactly enough to appear as an arc of a circle. Cast the shadow upon the vertical plane according to principles brought out in the preceding problems.

Fig. 2.—Find the dividing line of light and shade on both the circular plinth and cylinder. The shadow cast upon the vertical plane may be found by points or by method given in Fig. 4, Plate 26. The intersection of the shadow upon the vertical plane with the cylinder in 1 will locate the first point of shadow upon the cylinder. Point 1 will also determine the height of 2, as it will be seen in the top view that they are equally distant from the central ray R, which passes through the axis of the cylinder. Point 3, which lies in ray R, is determined by first revolving ray R in the front view until it becomes parallel to the vertical plane in line 4-5 (at an angle 35° 16′). This line swung back to its apparent angle of 45° will intersect the horizontal line from point 6 in 3. Point 8 is found by cutting the dividing line of light and shade with an arc which is drawn with 9 as center and 9-7 as radius. The arc 7-8-5 is the shadow of a portion of line A B upon an auxiliary plane which is supposed to be passed through the dividing line of light and shade at an angle of 45° with the vertical plane. This plane is represented in the top view as C D. Fig. 3 demonstrates by actual projection that a horizontal circle (such being the lower surface of the plinth) will cast a circular shadow upon an oblique plane at 45°. The actual shape of the shadow cast upon this plane is elliptical, but it is so foreshortened as to appear circular.

FIG. 1.

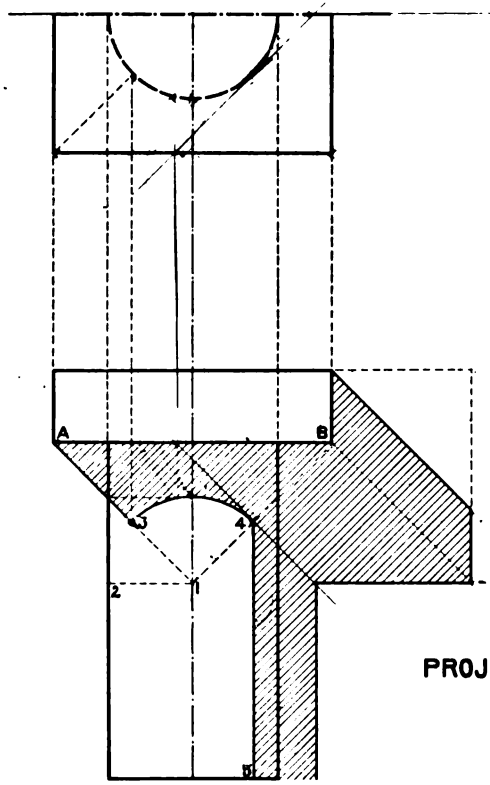


FIG. 3.

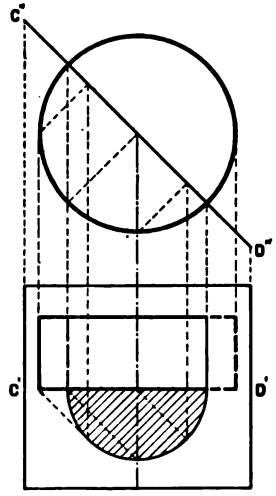
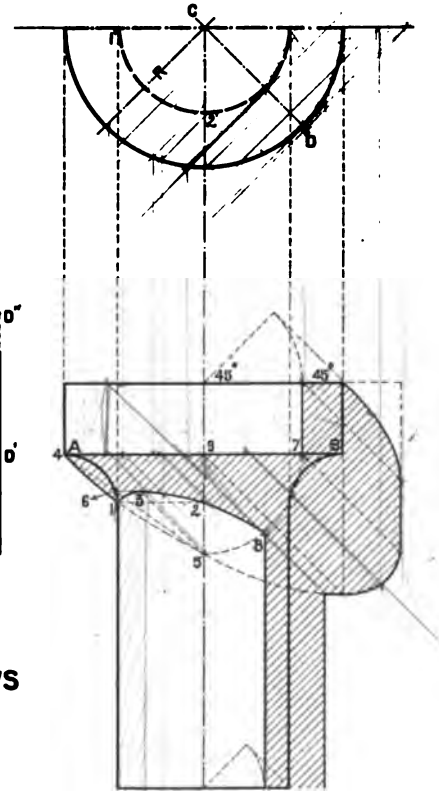


FIG. 2.



PROJECTION OF SHADOWS

Plate 36.—Before beginning this plate, the student should thoroughly understand the principles brought out in the previous sheet.

Fig. 1.—The half column is resting with its axis against the vertical plane upon which the shadow is cast. Points 1 and 1′ on the contour of the torus are found by drawing 45° tangents. As the object is symmetrical, 3 will be on a level with 1. Point 5′ is the lowest point in the curve, and is found by revolving a ray of light until parallel to the vertical plane, when it will become tangent to the torus in 2. Project point 2 over horizontally until cut by a ray brought back from 5 at 45°. The shadow cast by the dividing line of light and shade on the torus, upon the vertical plane, will pass through points 1, 5, 3′, 4′ and 1′. Point 5 is found in the axis which is resting upon the vertical plane. 3′ is cast by 3, which distance in front of the vertical plane is equal to 3-6. From 6 let fall a vertical line to be cut by a 45° line from 3 in 3′. Point 4′ is cast by 4, the distance of which in front of the vertical plane is equal to 4-7. Lay off 4-7′ equal to 4-7. and proceed as in the last point explained.

The method of casting the shadow of line A B is explained in Plate 26. The dividing line of light and shade of the torus will cast a shadow upon the column. Points 8 and 9 are on the same level, 8 being the intersection of the column with a shadow already found upon the vertical plane. Point 5″ will be the highest point in the curved shadow, being cast by the lowest point (5′) of the dividing line of light and shade on the torus, and the same revolved ray is used in finding 5″ as when obtaining 5′. Point 10 is found similarly to point 8 on Plate 35, Fig. 2. In this figure, however, we have the dividing line of light and shade of the torus instead of a circle, casting a shadow upon the imaginary oblique plane. The shadow of this dividing line will produce an oval curve passing through points 4, 3″ and 5. The intersection of this oval curve with the dividing line of light and shade on the column will give point 10. The shadow of point 3 upon the oblique plane will give 3″. This is found by passing a horizontal plane through 3, producing a horizontal circle, the shadow of which, when cast upon the oblique plane, gives arc 11-3″. This arc cut by a 45° line from 3 gives 3″. Point 11 is found as in point 7, on Plate 35, Fig. 2.

Fig. 2.—The dividing lines of light and shade upon this object are so simple that explanations are not necessary.

Fig. 3.—First find the dividing line of light and shade of the torus, as in Fig. 1. The fillet may be con-

FIG. 1.

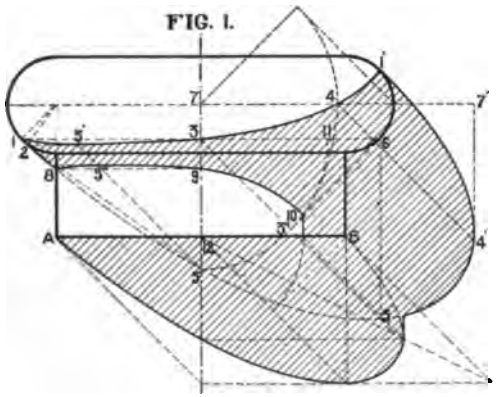
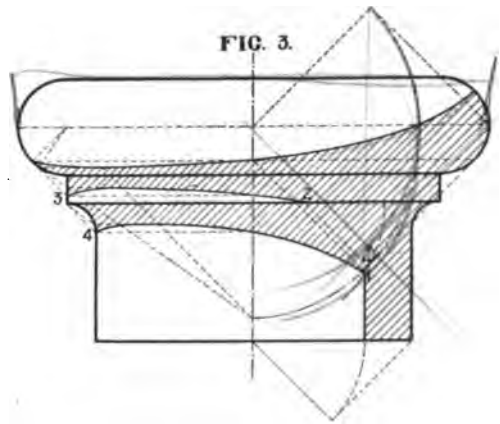


FIG. 3.



PROJECTION or SHADOWS

FIG. 2.

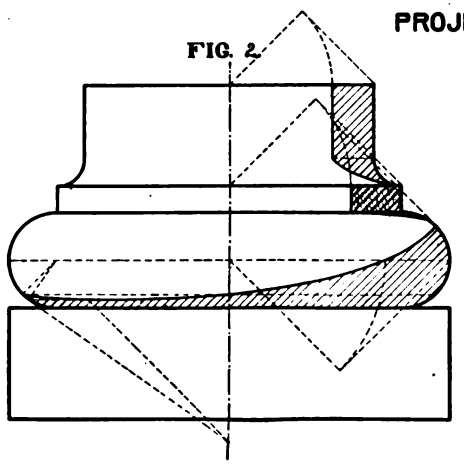
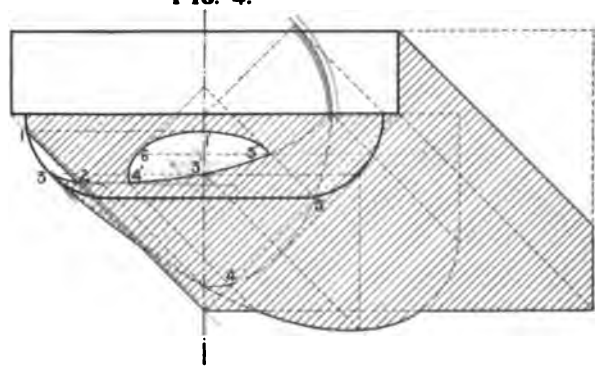


FIG. 4.

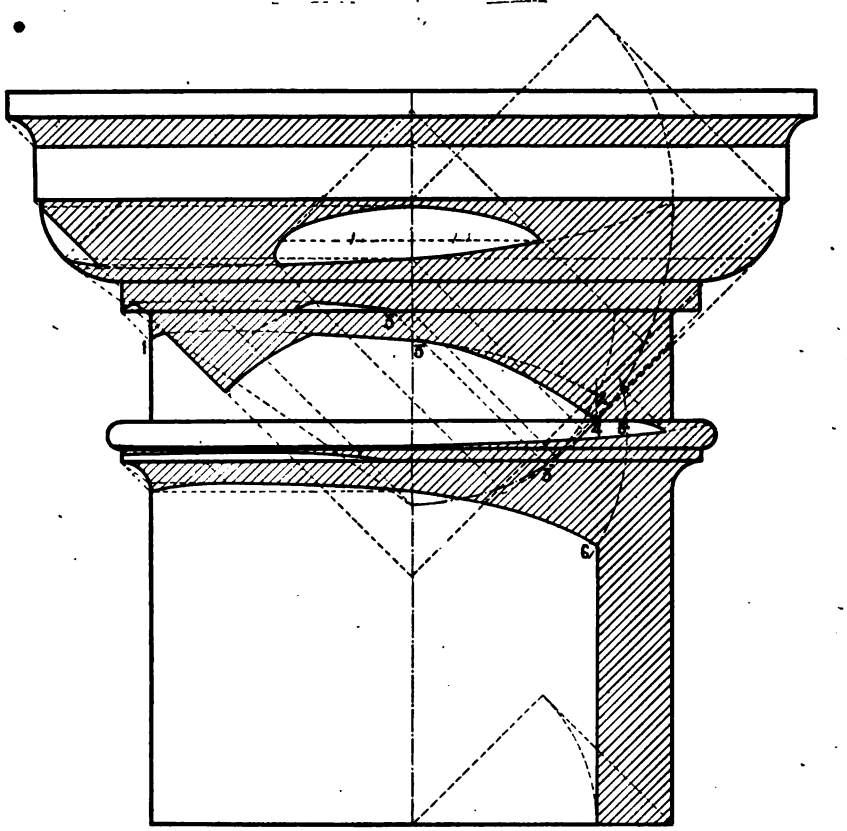


sidered as a portion of a cylinder and the shadow found as in Fig. 1. The shadow upon the column is cast by the fillet. Point 1 is found as point 8, in Plate 35, Fig. 2. Point 2 is found by projecting back at 45° from point 2′, which point is cast by the shadow of the fillet crossing the oval curve, both being upon the oblique plane. Points 3 and 4, as will be seen by comparison with Fig. 1, are located approximately by tangents at 45°, this being near enough for all practical use.

Fig. 4.—The shadow cast upon the vertical plane differs little in principle from that in Fig. 1. The horizontal line of the abacus, which is at right angles to the vertical plane, will cut off a patch of light on the echinus at 45° in line 1-2. As the object is symmetrical it is evident that the front horizontal line will produce a similar patch of light. This being so, point 1 may be projected over horizontally to 1′, and 3 over to 3′. Points 4′ and 5′ are found by projecting from 4 and 5, which points are caused by the intersection of the oval curve with the shadow of the lower line of the abacus upon the oblique plane. Points 5 and 6 are at equal distances from the axis.

Plate 37.—Having thoroughly comprehended the preceding plate, the student will have little difficulty in working this, as we have here a union of the several members explained in that sheet. Line 1-2 is cast by the lower line of the fillet. Line 3′-4 is cast by a portion of the dividing line of light and shade of the quarter round. Points 3 and 3′, which are cast by the dividing line of light and shade of the quarter round, are found by projecting back a line at 45° from 3″, which point is caused by the intersection of the oval curve with the shadow cast by the lower line of the fillet upon the oblique plane. Arc 5-6 represents an imaginary shadow of the astragal cast upon the oblique plane, cutting the dividing line of light and shade of the column in 6. Strictly speaking, the dividing line of light and shade of the astragal would not cast an arc of a circle; but it so nearly approaches a true circle that it is considered as such.

PROJECTION of SHADOWS



TUSCAN CAPITAL

CHAPTER VI.

INSTRUMENTAL PERSPECTIVE.

An instrumental perspective of any object is supposed to be drawn upon a transparent plane with the eye stationed at some particular point in front. While looking at any object from this fixed point through the transparent plane, lines may be imagined drawn upon it which would cover the outlines of the object; for instance, one might stand in front of a window and trace upon a pane of glass the outlines of a building in the distance. Such a tracing would illustrate an instrumental perspective. Line A B in Plate 38 represents the top view of this transparent plane, called the picture plane (P. P.). C D in the front view represents the intersection of the transparent plane and the ground plane, and is called the ground line (G. L.). E F, which is also in the front view, represents the horizon line (H. L.), and is located upon the transparent plane. The distance between this and the ground line is governed by the height of the eye above the ground. The distance from the picture plane to the eye, or station point (S. P.), as presented in the top view, indicates the distance the observer is from the picture plane.

Plate 38.—Draw two geometric solids of given dimensions at angles of 45° to picture plane, with the station point 2′-4″ in front of the picture plane, the horizon line 13″ above the ground, the angle A 10″ to the left of station point, and angle B 10″ to the right of station point, and 1″ within the picture. Scale ¼ in. equals 1 in. The principal lines may be located by actual measurement as follows: Margin lines 12″ x 19″. G. L., 2½″ above lower margin. P. P., 8″ above lower margin. S. P., 10″ to right of left margin.

The vanishing points of any system of parallel lines may be found by drawing a line from the station point parallel with that system of lines until it intersects the picture plane. Therefore, to find the vanishing points of the rectangular bodies given in the top view, draw from the station point lines parallel with the edges of the object, which will cut the picture plane in vanishing points 1 and 2 (V. P. 1, and V. P. 2). As the front edge of the cube is resting against the picture plane, we have simply to project it down to the front view and measure off its actual length, 1-2 from the ground line. From points 1 and 2 draw lines to V. P. 1 and V. P. 2. The length of these lines is determined by drawing lines from 3 and 4 to the station point, intersecting the picture plane in 5 and 6. From 5 and 6 project vertical lines, cutting the lines already drawn from 1 and 2, and forming two edges of the cube. From point 3′ draw a line to V. P. 2; from point 4′ draw a line to V. P. 1, intersecting the line from 3′ in 7. The back edge of the cube may be found by letting fall a vertical line from point 7 to intersect lines to the vanishing points from points 3″ and 4″.

The second object does not rest against the plane, therefore its front vertical line cannot be measured directly, as in the first problem. We must prolong the plane of one of its sides, and in this case we will prolong the left-hand one, meeting the picture plane in point 8. Drop a vertical line from this point, which line will be upon the picture plane. Being upon the picture plane, its true length can be measured on this line, giving 8′-9. Draw lines from points

8′ and 9 to V. P. 1, locating the plane in which the square is contained. Draw a line from point 10 to the station point, intersecting the picture plane in 11. Drop a line from this point until it crosses the lines drawn from 8′ and 9; this will be the nearest vertical edge of the object. The rest of the problem is worked out on the principles illustrated in the cube.

In casting shadows, we may suppose the light to be coming downward from the left in rays parallel with the picture plane and 45° with the ground. Vertical lines will always cast horizontal lines of shadow upon a horizontal plane, and vertical shadows upon a vertical plane. A line casting a shadow upon a plane parallel with itself will produce a parallel line of shadow; in other words, this line of shadow will go to the V. P. of the line casting it. In the cube, line 1-2, being vertical, will cast a horizontal line of shadow on the ground, which will be cut off by a line drawn from point 2 at an angle of 45°, giving point 12. Line 2-4′, being horizontal, will cast a line of shadow parallel to itself on the horizontal plane; and as one extremity of the line strikes the horizontal plane at 12, a line drawn from 12 to V. P. 2 will be this line of shadow, which will be intercepted at point 13 by the second rectangular object. Should the vertical line under point 4′ cast a shadow, this shadow would extend across the ground plane in a horizontal direction, and upon reaching the vertical plane, would take a vertical direction until cut by a ray of light at 45° from point 4′, giving point 14. Connect points 13 and 14, completing the shadow of line 2-4′. A portion of the line 4′-7 is parallel with the receiving surface, consequently its shadow must be parallel with it, or go to its vanishing point; therefore, draw a line from 14 to V. P. 1, which will determine its direction. The process of finding the shadow of the remainder of the cube is similar to that already found.

The main portion of the second figure is similar to that of the first. The shadow of the apex of the triangle is found by letting fall an imaginary line until it intersects the horizontal plane in 15, and intersecting the horizontal shadow of this imaginary line by a line of 45° from the apex in point 16. Having found the several points, connect them by straight lines.

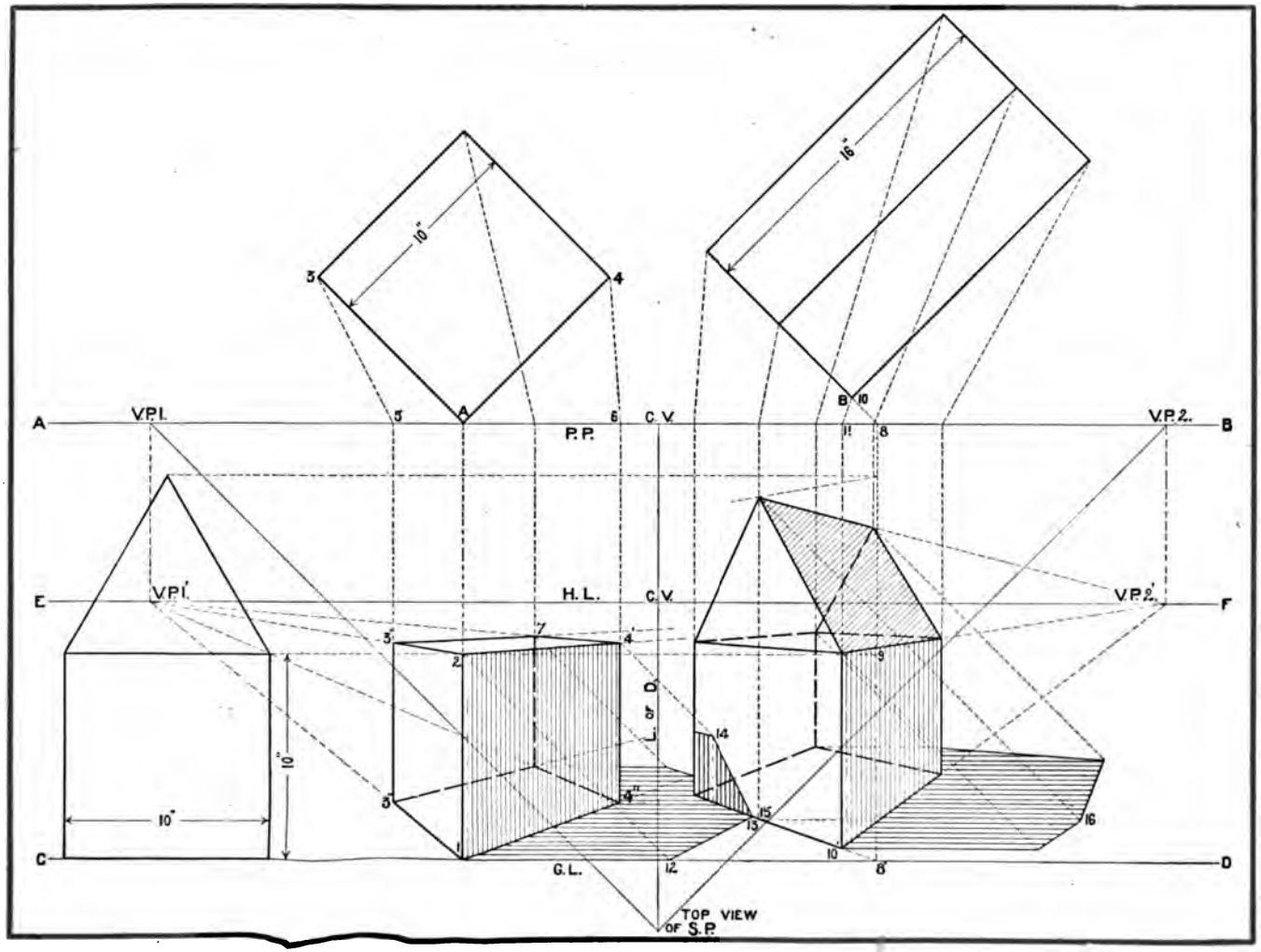

10"
16"
A
B
C
D
E
F
V.P.1.
V.P.1'
V.P.2.
V.P.2'
P.P.
H.L.
C.V.
G.L.
L. or D.
TOP VIEW OF S.P.
10"
10"

Plate 39.—Draw a pyramid of steps according to given dimensions at an angle of 45° to the picture plane. The station point is 2′-4″ in front of the picture plane, the horizon line 9″ above the ground line, angle A 7″ to the left of station point, and 2″ within the picture. Scale ¼ in. equals 1 in. The principal lines of the diagram may be located by actual measurement as follows: Draw margin line 12″ x 19″; G. L., 1½″ above lower margin; P. P., 7½″ above lower margin; and S. P., 11″ to right of left margin. The vanishing points and station point do not appear upon this and the following sheets, for want of space; but they will be upon the plates drawn by the student, if he follows the measurements given. In this and in all other sheets, carry out system of lettering, as in first plate. Angle A is found, and the first step is drawn by principles illustrated in Plate 38. To find the second step, prolong its right-hand face until it intersects the picture plane in point 1. Project a line downward and measure upon it the thickness of the first and second steps from point 1′. Draw lines to V. P. 2, which will determine the upper and lower lines of the step. Project point 2 down perspectively, as before done with A, until it intersects these two lines, which will give the nearest vertical edge of the second plinth. Complete the step. Find the prism by the same method. The shadows in this drawing are so simple that they need no explanation.

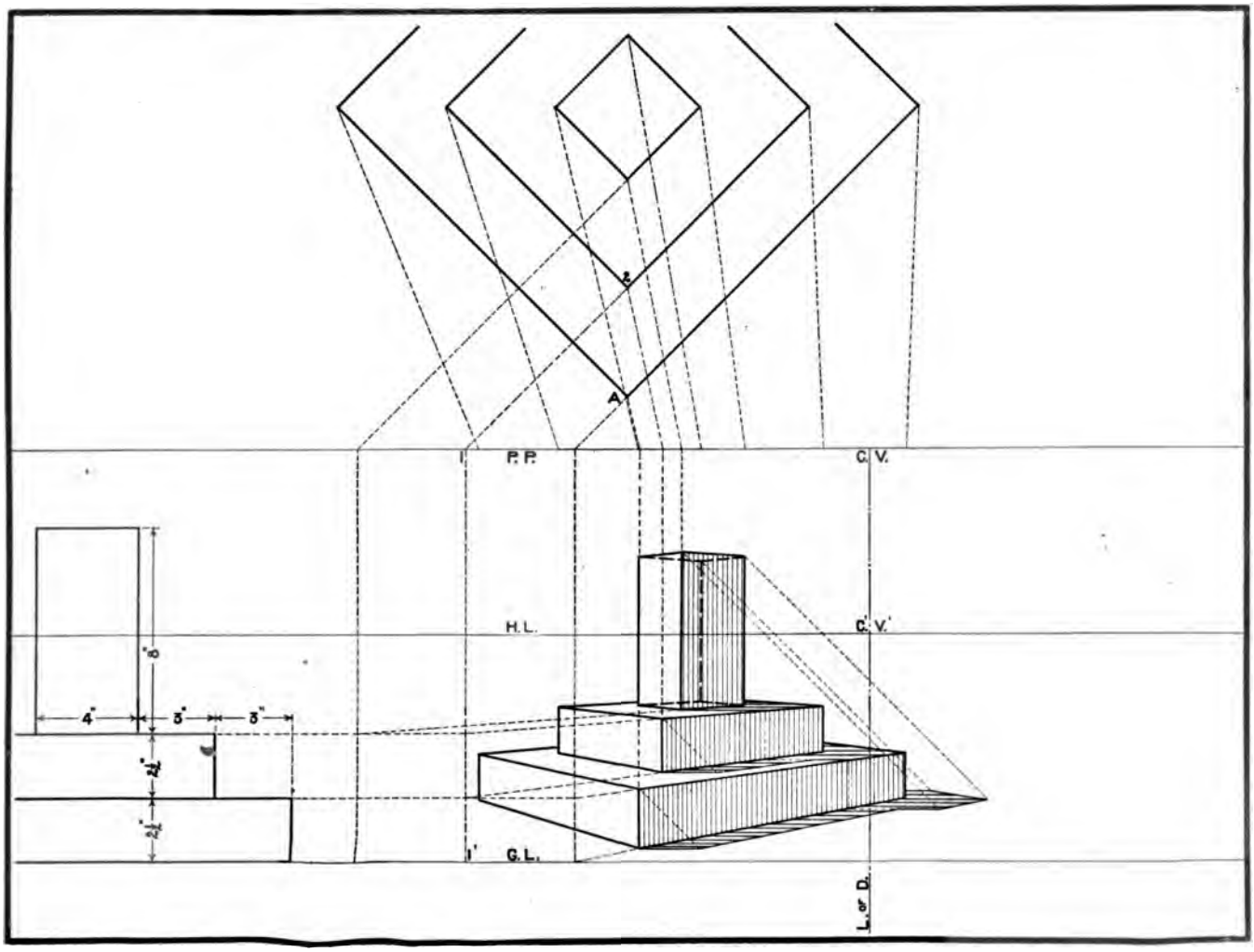

P.P.
C.V.
H.L.
C.V.'
G.L.
L. or D.
A
4"
3"
3"
8"
2½"
2½"

Plate 40.—Draw a box of given dimensions, having the lid thrown back at an angle of 45° to the horizontal plane. The long sides of the box are to be at an angle of 30° with the picture plane, the station point 23″ in front of picture plane, the horizon line 12″ above the ground line, angle A 2″ to the right of station point and 1″ within the picture. Scale ¼ in. equals 1 in. The principal lines of the diagram may be located by actual measurements, as follows: Draw margin lines 12″ x 19″; G. L., ¾″ above lower margin; P. P., 6″ above lower margin; and S. P., 6″ to right of left margin. The main lines of this box are placed at angles of 30° and 60°, instead of 45° as in previous drawings; accordingly lines drawn from the station point to obtain the vanishing point should also be at 30° and 60°, in other words, parallel with the main lines of the object. The long oblique lines of the cover of the box may be obtained by projection, as shown in this drawing, or by finding their vanishing point. To do this, take V. P. 1 as a center, the distance to the station point as a radius, and describe an arc cutting P. P. in 1. Project point 1 down to the H. L., giving 1′. From 1′ draw a line parallel with the slant line of the cover (at 45°), intersecting a vertical line drawn through V. P. 1, which point will be the vanishing point of the oblique lines of the cover. The vanishing point of the short oblique lines will be found by drawing a line from 1′ downward, parallel to the corresponding edges of the cover (at 45°), until it intersects the vertical line passing through V. P. 1.

The shadow cast in the box may be found by passing any assumed vertical plane, as 2-3, parallel with the picture plane, and appearing as a straight line in the top view; which plane produced in perspective will cut the end of the box in a vertical line 3′-4. The ray of light passing through 2′ in this plane will cut the line 3′-4 in 5, giving one point of the shadow cast by that line. As the shadow must begin at angle 6, we have simply to draw a line from angle 6 through point 5, giving us the direction of the shadow. The method of determining other lines of the shadow has already been given.

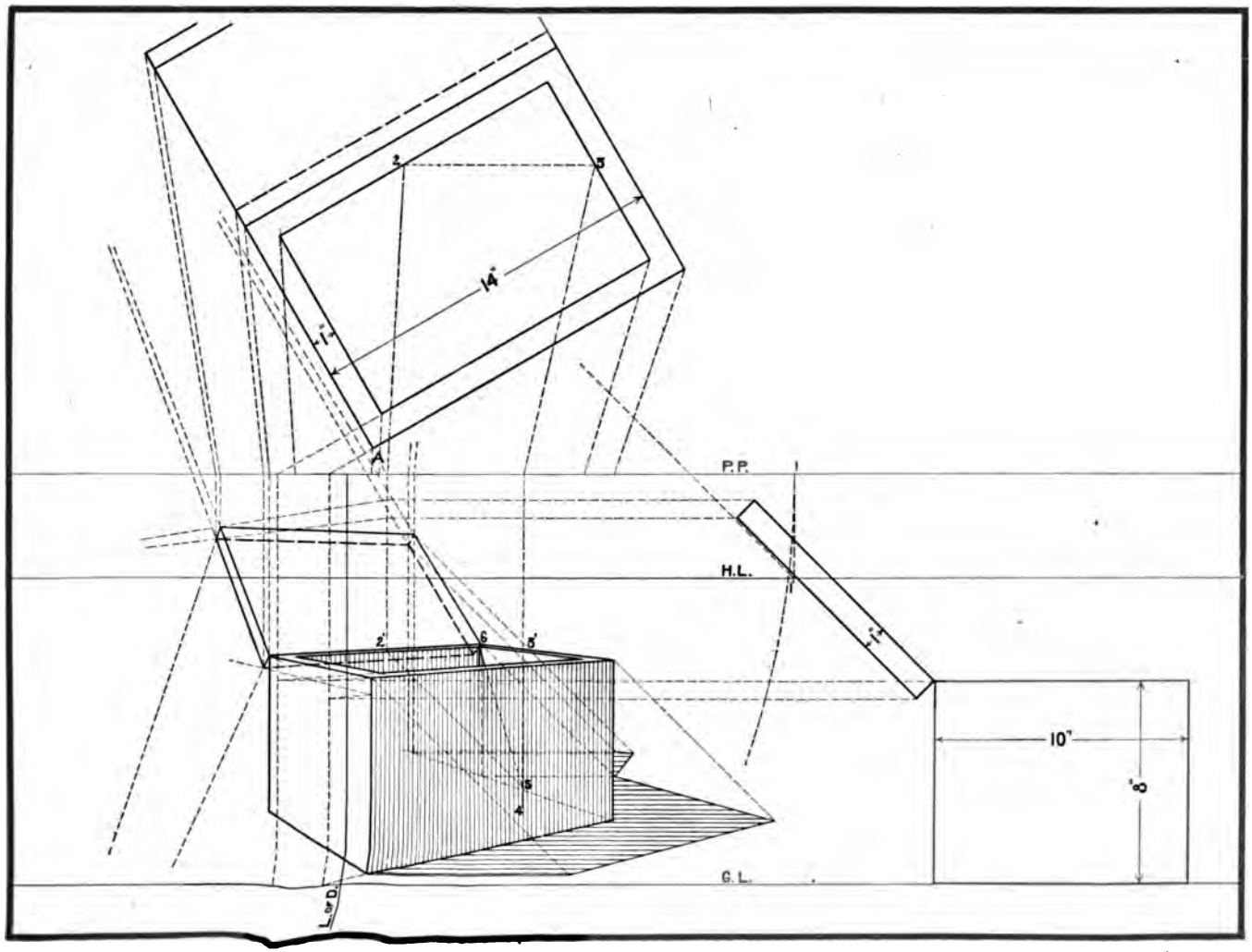

2
3
14"
1"
A
P.P.
H.L.
2'
6
5'
1"
10"
8"
15
4
G.L.
L. & D.

Plate 41.—Draw the corner of a house according to given sketches, the front extending to the right at an angle of 30° to the picture plane, the station point 26′-0″ in front of picture plane, the horizon line 9′-0″ above the ground, angle A 4′-0″ to the right of station point, and 4′-0″ within the picture. Scale ¼ in. equals 1 ft. The principal lines of the diagram may be located by actual measurement, as follows: Draw margin lines 12″ x 19″; G. L., ½″ above the lower margin; P. P., 7¼″ above lower margin; S. P., 8¼″ to right of left margin. First draw the two elevations, then locate the plan according to the conditions of the problem. The steps, water table, string courses and trim about the door and window should not be considered until the main walls are drawn. The student should note that the trim occupies a different plane from that of brick and stone work, consequently it becomes necessary to use two separate planes, finding the lines of brick and stone in one and the trim in the other.

Plate 41.

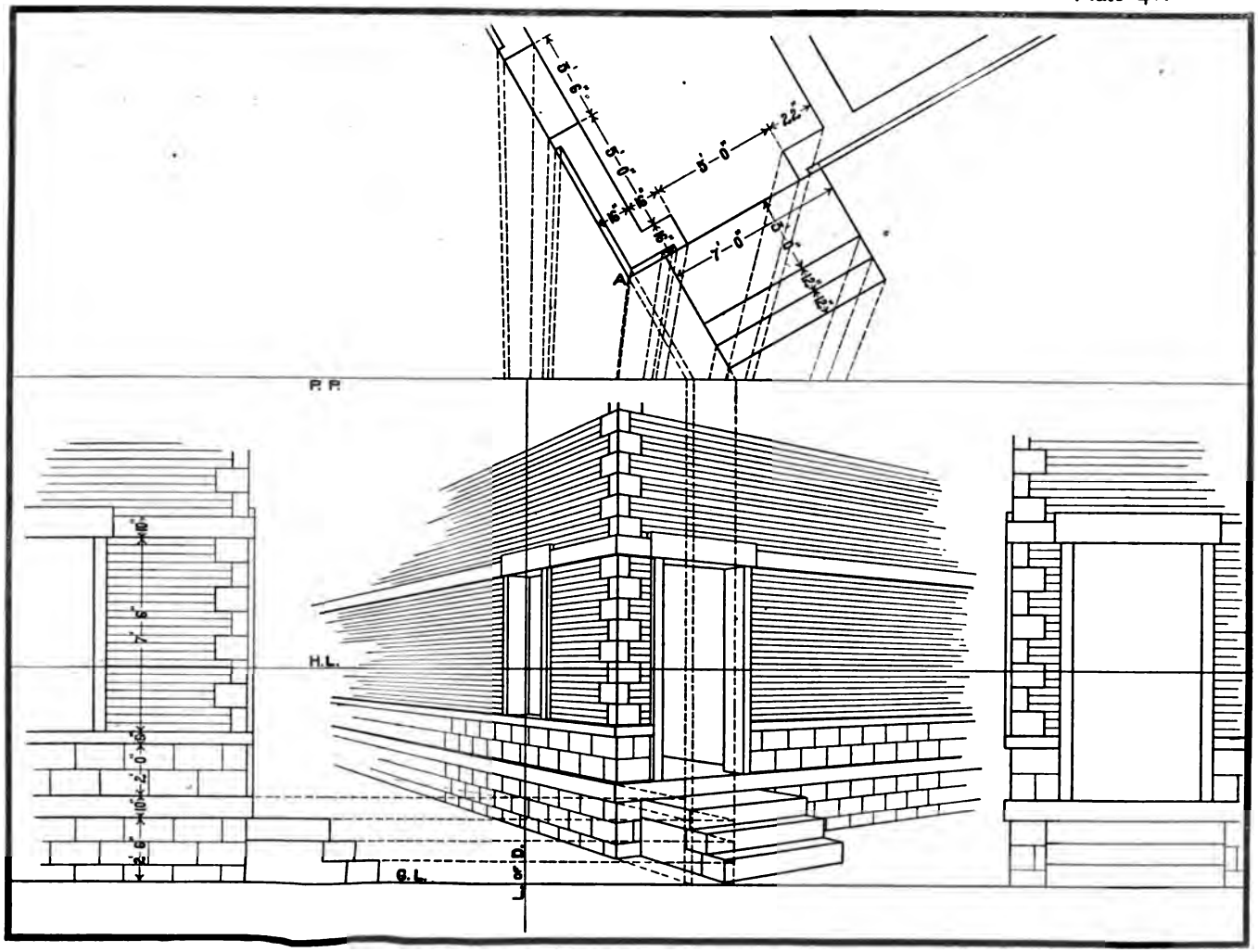
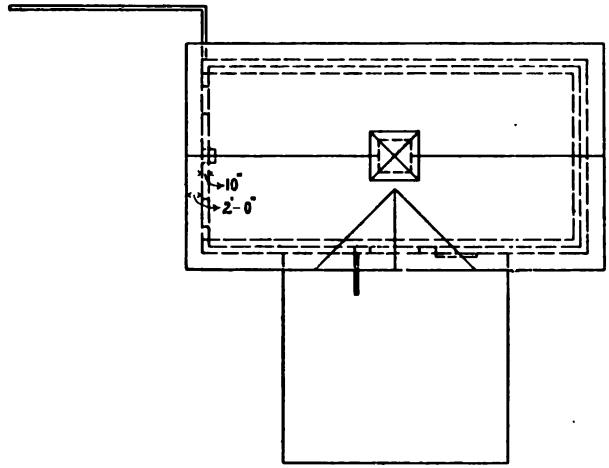
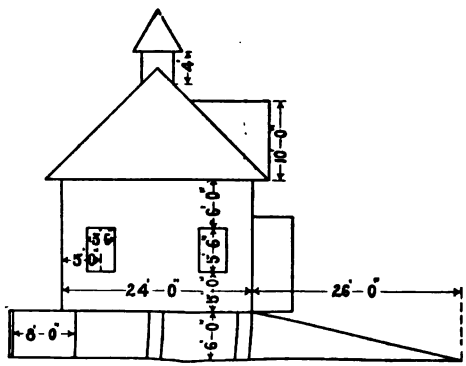


Plate 42.—The front, top and side views of a stable with its general dimensions are given, the perspective of which will appear in the following plate.

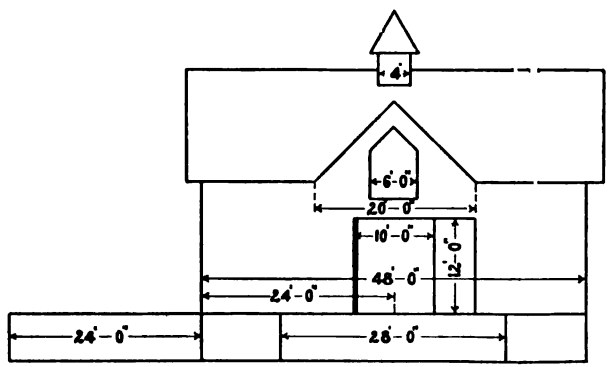
PLAN AND ELEVATIONS OF BARN



TOP VIEW



SIDE VIEW

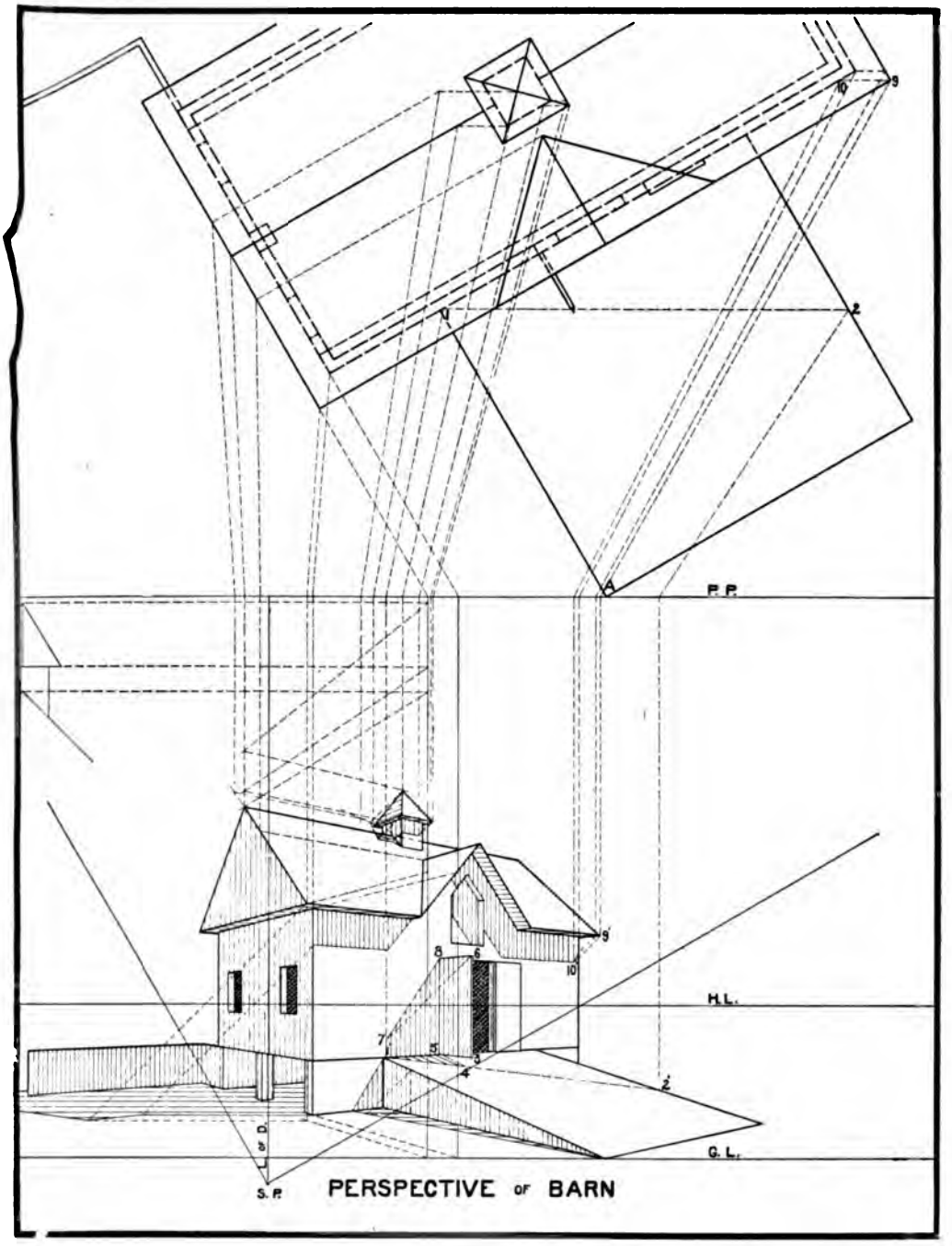


FRONT VIEW

Plate 43.—Draw in perspective a barn of given dimensions (according to Plate 42). The long side is to be placed at an angle of 30° to the picture plane, station point 46′-0″ in front of the picture plane, the horizon line 12′-0″ above the ground, angle A 27′-0″ to the right of station point. Scale $\frac{1}{8}$ in. equals 1 ft. The principal lines of the diagram may be located by actual measurement, as follows: Draw margin lines 12″ x 19″, G. L. $2\frac{1}{2}$″ above lower margin, P. P. $11\frac{1}{2}$″ above lower margin, and S. P. 3″ to right of left margin. Draw first the rectangular body of the barn, not considering any of its details. Having completed the main body of the barn, locate the lower lines of the triangular roof. We must remember that the gable and sides of the roof project beyond the barn and consequently must be worked in a different plane. The student will readily see by the drawing how the lines of the cupola are determined.

In casting the shadows the light is considered as coming from the right at an angle of 45°. The shadow of the door falls partly upon an oblique plane and partly upon the vertical surfaces of the barn. To find the shadow upon this oblique surface, pass a vertical plane 1-2 parallel with the picture plane, through the edge of the door, appearing in the top view as a horizontal line. Project points 1 and 2 down perspectively, giving 1′-2′. Connect 1′ and 2′ by a straight line, and intersect this line by one at 45° from point 3, giving 4. Draw 4-5, which will be the shadow of the lower edge of the door. The shadow of 3-6 will travel along in line 4-1′ until it reaches the vertical surface, and then up in a vertical line until cut off by a line at 45° from point 6 in 7. Connect points 7 and 8. The principles just explained should be carried out in casting the shadow of the cupola on the oblique plane of the roof. To find the shadow cast by the cornice, use a vertical plane 9-10 in the top view, which when projected down perspectively will produce a vertical trace upon the side of the barn. This trace, when cut by a line at 45° from 9′, will give point 10′. This gives the shadow of one point of the cornice, through which draw a line perspectively parallel with the line of the cornice. The remainder of the shadows need no further explanation.

Plate 43.



PERSPECTIVE OF BARN

Plate 44.—This plate is given to illustrate the simple methods by which circles and semicircles may be drawn in perspective. Lay out the diagram and place the geometric solids as given in this drawing. The student should at this stage of the work be able to lay out the diagram and arrange the sheet satisfactorily. The figure at the left is resting against the picture plane, the station point being directly in front. From this point of view the horizontal circles are seen as perfect ellipses, the long diameters of which are horizontal lines; but if seen from a point to the left or right, the diameters will appear to slant. The same figure placed at the right illustrates this. In this the horizontal circles become so much distorted as to appear unnatural. This should be corrected as far as possible in practical work. Of course an exaggerated case is shown. In the first figure, the left vertical semicircle is found by dividing the semicircle into a certain number of equal parts, finding the perspective of each point in the semicircle separately, and through these points drawing the elliptical curve. The lines of the arch on the right portion of the same figure are found by enclosing the semicircle within a semi-octagon, and after placing the semi-octagon in perspective, draw the ellipse which will pass through the center point of each line, or, in other words, be tangent to the sides of the octagon. Either method may be used for the upper horizontal circles.

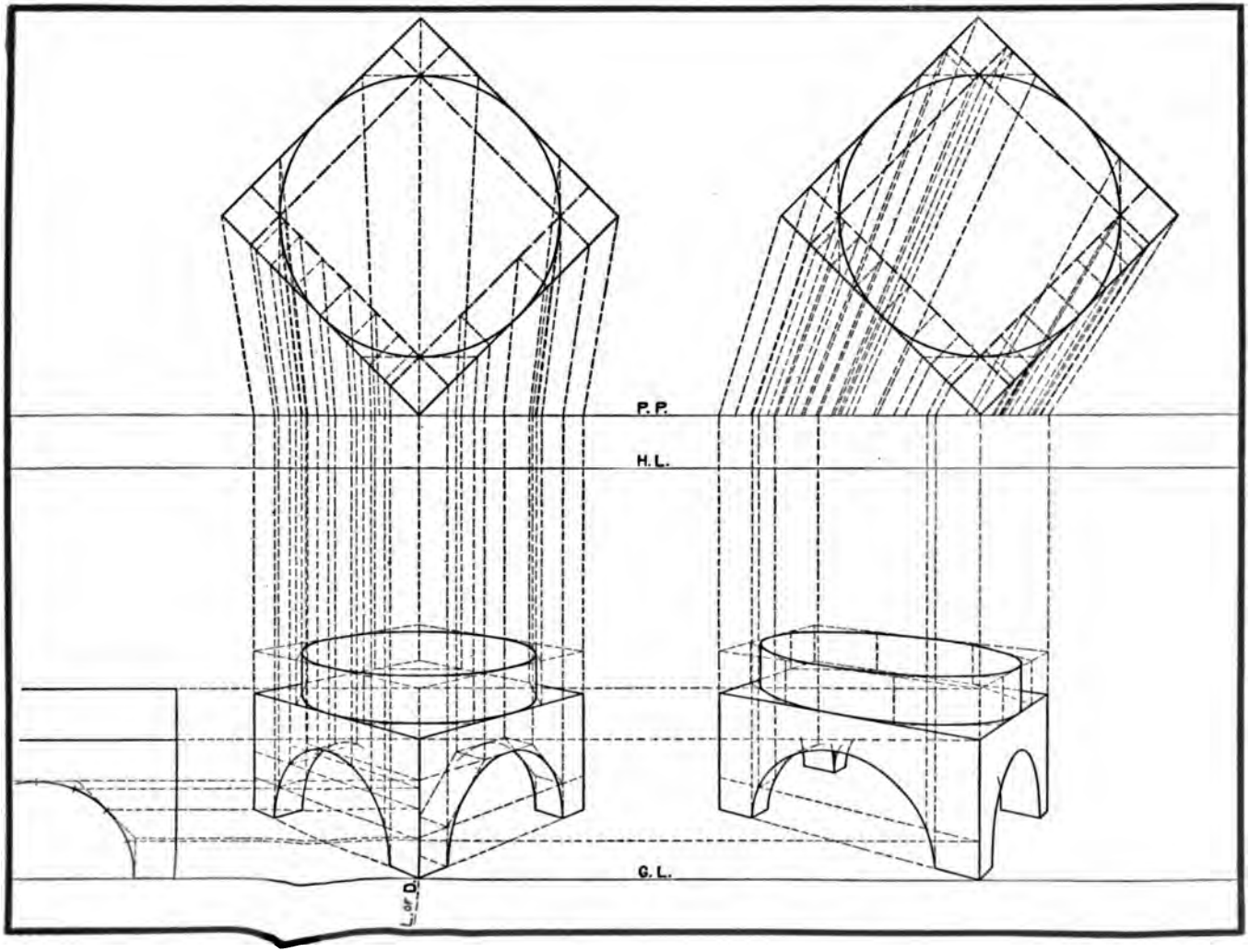
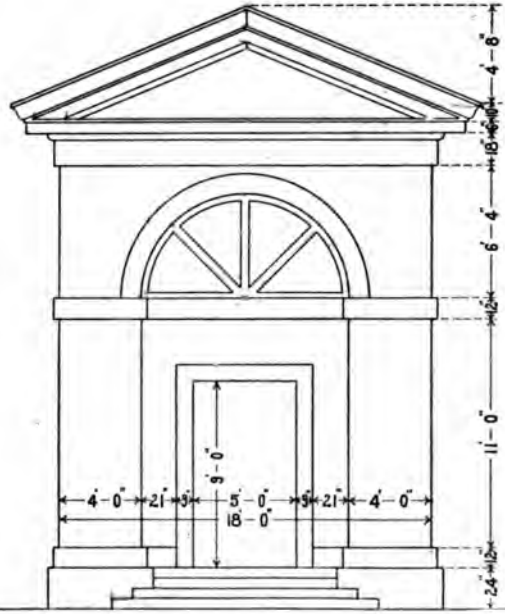
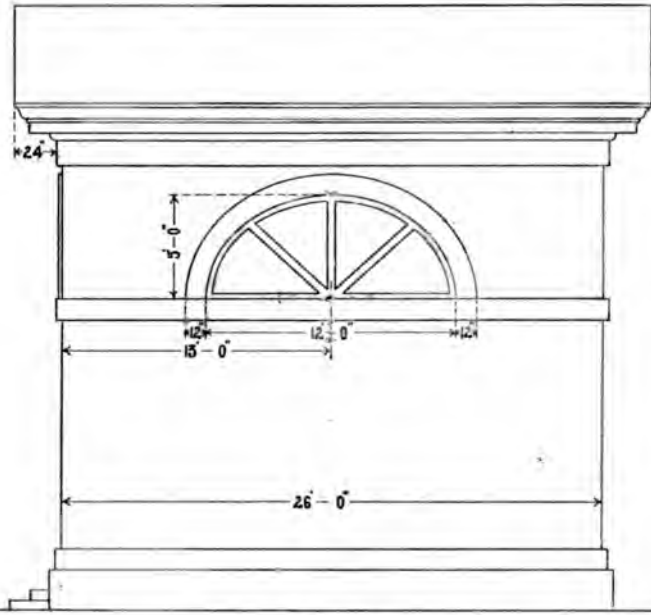

P.P.
H.L.
G.L.
L. of D.

Plate 45.—This plate gives the front and side views of a simple tomb to be drawn according to measurements given, the perspective of which will appear on Plate 46.

ELEVATIONS or TOMB



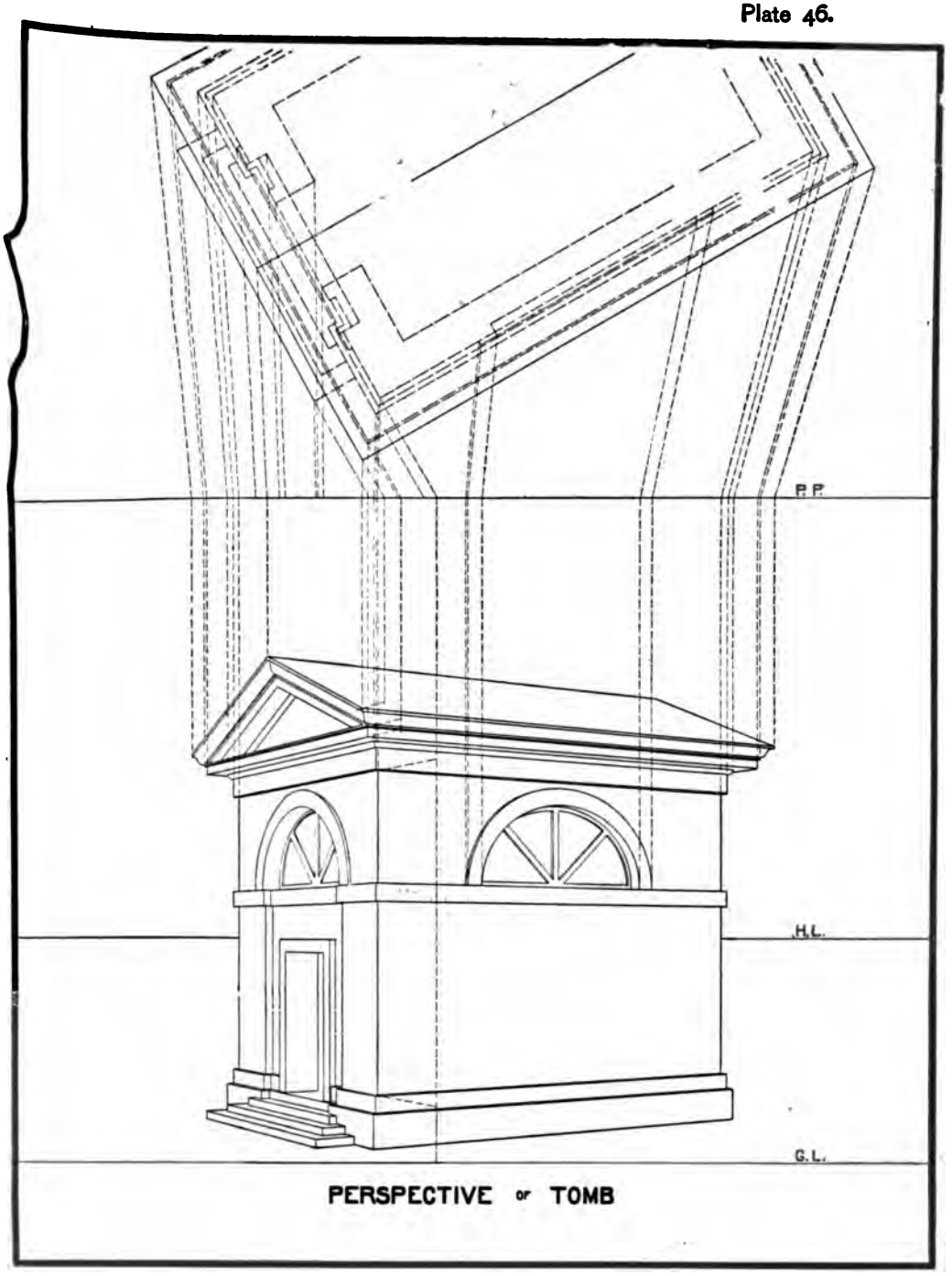
FRONT VIEW



SIDE VIEW

Plate 46.—If possible, this plate should be worked upon a large sheet of paper which may be made a vertical or a horizontal sheet, as will better fit the problem. The principles brought out in this plate differ but little from those already presented. In laying out the cornice, only two or three main outlines will be found necessary. Having found these, connect the points or extremities of the lines by the various curves. The student should make an effort to have the station point as far in front of the picture plane as possible, so that the vanishing points may be some distance apart; otherwise the building will appear very much distorted.

Plate 46.



PERSPECTIVE OF TOMB

Plate 47.--Draw in perspective the simple outline of a building of given dimensions at an angle of 45° to the picture plane. Station point 46′-0″ in front of the picture plane, horizon line 6′-0″ above ground line, angle A 6′-0″ to the left of station point. Scale $\frac{1}{8}$ in. equals 1 ft. The principal lines of the diagram may be located by actual measurement, as follows: Draw margin line 12″ x 19″, ground line $5\frac{1}{8}$″ above lower margin, station point $9\frac{1}{2}$″ to the right of left margin. This plate presents a method in which horizontal lines may be measured without the use of the top view. The principles of finding the vanishing points in this drawing differ little from those in the foregoing sheets. In this method the points are found directly on the horizon line without the use of the top view. The measuring points are found by taking V. P. 1 as center, and with radius V. P. 1 to S. P., describing an arc cutting the horizon line in M. P. 1; M. P. 2 is found in a similar manner. The student will readily see that all horizontal lines are measured by means of triangles, one side of which vanishes to the measuring point. To measure 19′-0″ upon the horizontal line drawn from angle A to V. P. 1, lay off 19′-0″ on the ground line to the left of A, giving B, from this point draw a line to M. P. 1, which is the measuring point of all lines going to V. P. 1. The 22′-0″ line going to V. P. 2 is laid off to the right, and from that point taken to M. P. 2. The reason why the line drawn from B to M. P. 1 measures the required distance A C, is shown in the diagram, which indicates the lines as they actually exist. Line A′ B′ is contained in the ground line as A B. A′ C′ takes the place of A C. Connect B′ C′ and we have an isosceles triangle. The student should note that a line drawn from S. P. to M. P. 1 is parallel with B′ C′, and that M. P. 1 consequently becomes the vanishing point of line B C, which cuts A C equal to A B. The system of measuring vertical lines does not differ from that already presented.

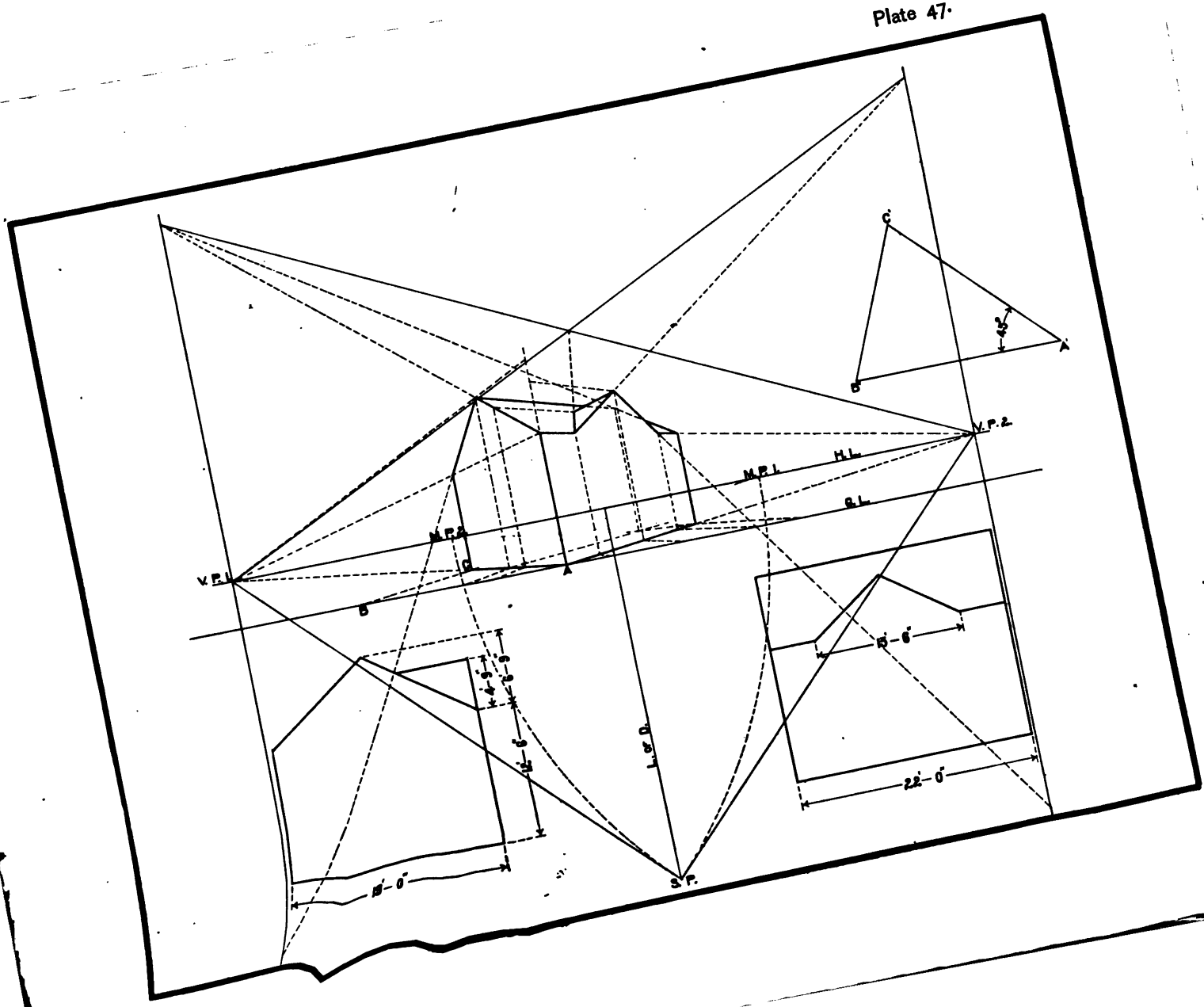
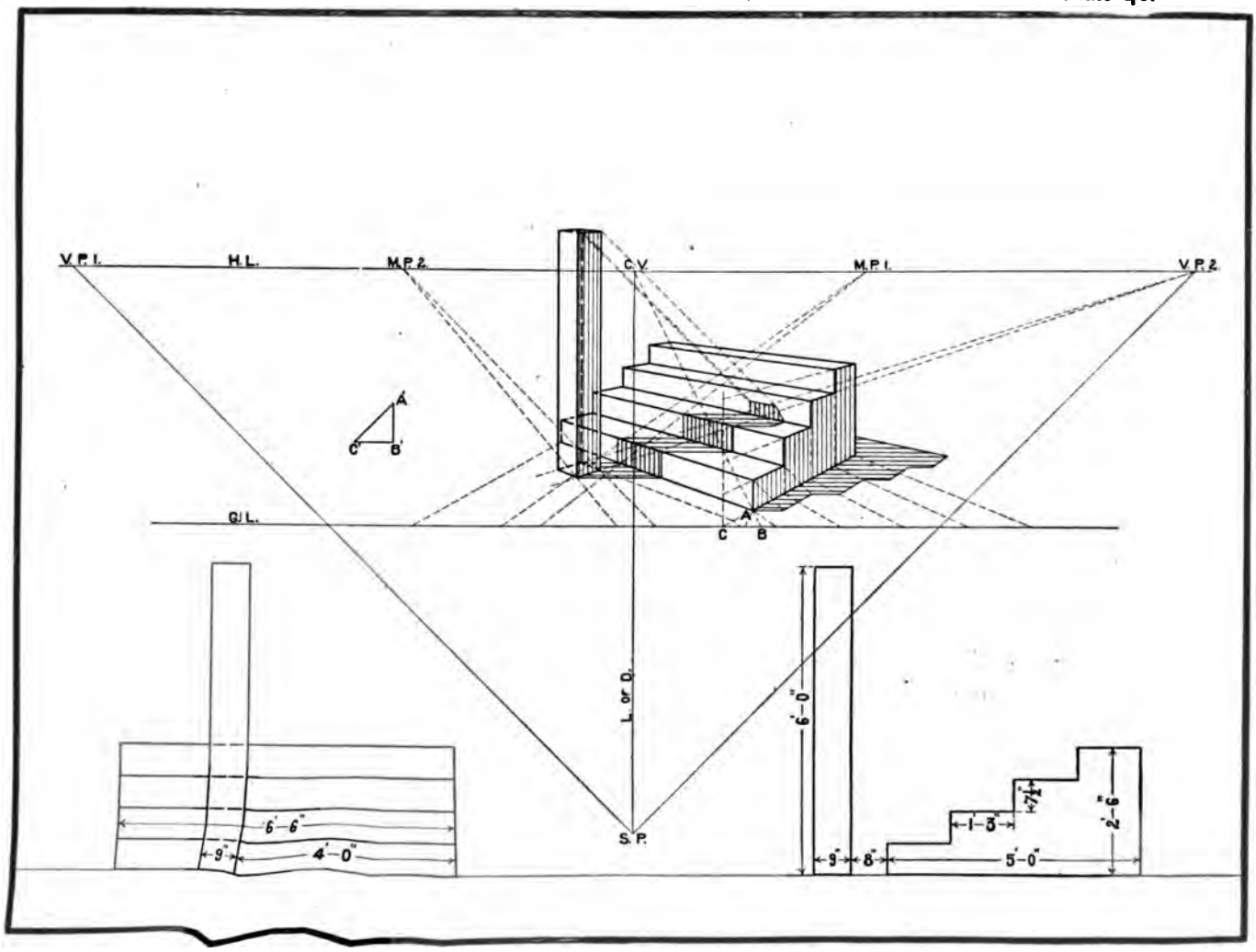

C'
45°
A'
B'
V.P.2
H.L.
M.P.1
G.L.
M.P.2
V.P.1
C
A
B
4'-9"
6'-6"
12'-6"
15'-0"
L. of D.
S.P.
15'-6"
22'-0"

Plate 48.—Draw in perspective a flight of steps and an adjacent post, according to the given dimensions, placed at an angle of 45° to the picture plane. Station point 11′-6″ in front of the picture plane, horizon line 5′-4″ above the ground line, angle A 2′-6″ to the right of the station point, and 9″ within the picture. Scale ¾ in. equals 1 ft. The principal lines of the diagram may be located by actual measurement, as follows: Draw margin line 12″ x 19″, ground line 4¾″ above the lower margin, station point 9½″ to the right of left margin. One of the principal features to be brought out in this problem is the finding of a point within the picture. Point A is 2′-6″ to the right and 9″ within the picture. From the line of direction lay off 2′-6″, giving point B. From this point draw a line to C. V. It is evident that any horizontal line drawn between these lines will be just 2′-6″. From point B lay off 9″ on the ground line to the left, giving point C. From C draw a line to V. P. 2, cutting the line already drawn in A. The diagram at the left shows these lines in their relative position. The line that measures a line going to the center of vision should always go to a 45° vanishing point, no matter at what angle the object may be turned. Having obtained this first point within the picture, proceed as in the last problem, making all the vertical measurements on the picture plane.


V.P.1.
H.L.
M.P.2.
C.V.
M.P.1.
V.P.2.
A
C
B
G/L.
A
C
B
L. or D.
S.P.
6'-6"
9"
4'-0"
6'-0"
9"
8"
1'-3"
7½"
2'-6"
5'-0"

CHAPTER VII.

ORDERS OF ARCHITECTURE.

Plate 49.—This plate gives the Tuscan, Doric, Ionic and Corinthian orders, according to the proportions set forth by Vignola, in which the module is used as a unit of measurement. The composite order is purposely omitted in this series, it being little used and differing but slightly from the Corinthian. This plate is not given as an exercise in drawing, but as a reference sheet to show the main proportions of the several columns. The module, according to Vignola, is equal to $\frac{1}{2}$ the diameter of the column measured immediately above the congé on the base. This module is divided into twelve parts when used for the Tuscan and Doric, but into eighteen parts for the Ionic and Corinthian. The measurements on the plate are given in modules and parts; the first figures indicating modules, and the second, parts.

Plate 49.

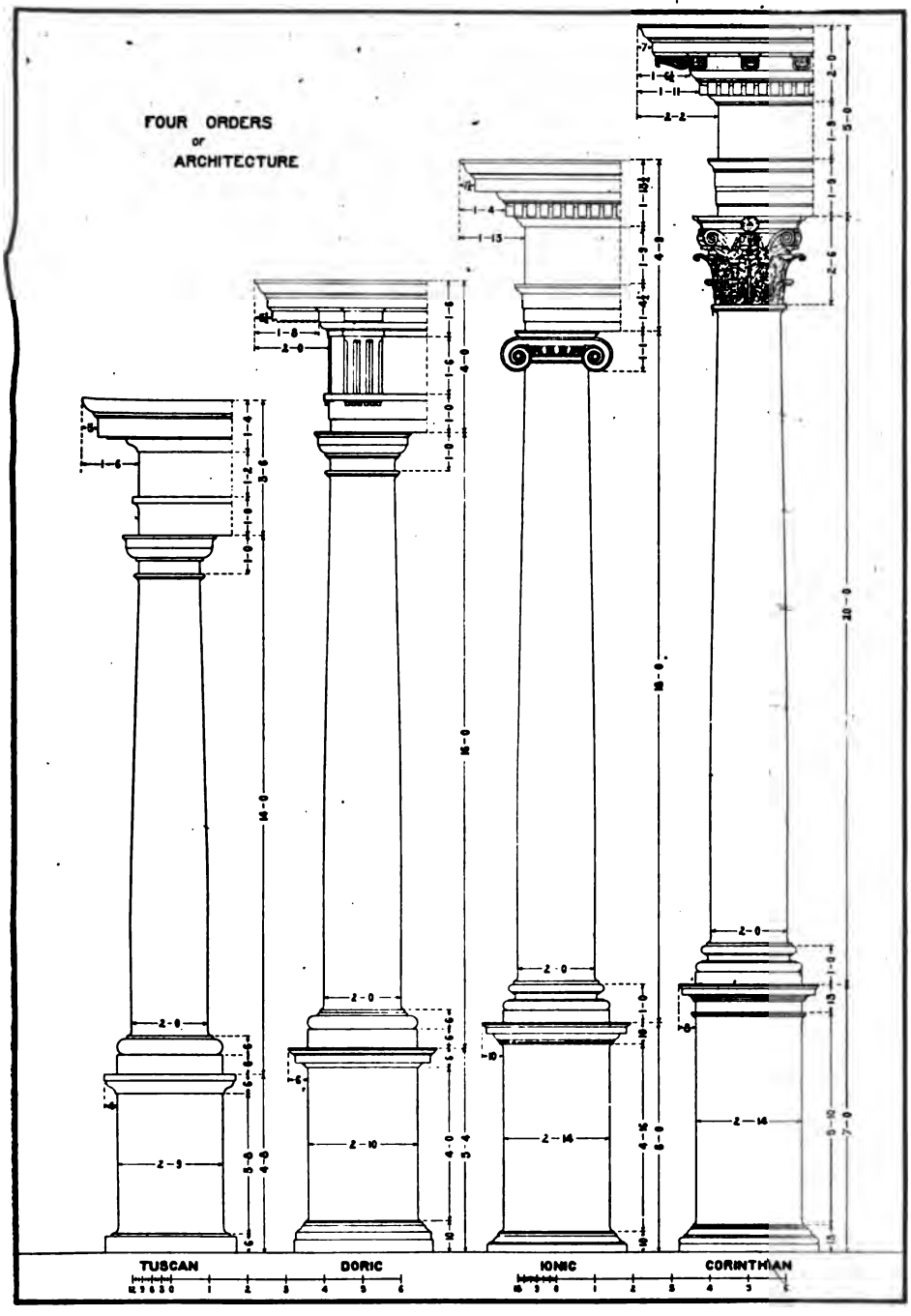

FOUR ORDERS
or
ARCHITECTURE
TUSCAN
DORIC
IONIC
CORINTHIAN

Plate 50.—The drawing in the lower right-hand corner gives a simple elevation of a tomb in which the Tuscan order is used. The drawing at the left, occupying a large portion of the plate, represents the working drawing of one of its columns and entablature, drawn according to the proportions given by Vignola. The measurements are indicated in modules and parts, and also in feet and inches, which are reckoned to the nearest eighth of an inch to which they figure mathematically, this being near enough for all practical purposes. This plate may be drawn by the use of a scale of modules or by feet and inches, the result being practically the same in either case. The elevation of the tomb being very small, many of the lines are omitted of necessity.

The technical terms applied to the various parts are as follows:

A—Quarter round.
B—Astragal.
C—Fillet.
D—Corona.
E—Listel.
F—Ogee.
G—Frieze.
H—Listel.
I—Architrave.
J—Listel.
K—Abacus.
L—Quarter round.
M—Fillet.
N—Neck.
O—Astragal.
P—Fillet.
Q—Shaft.
R—Shaft.
S—Congé.
T—Listel.
U—Torus.
V—Plinth.

Plate 50.

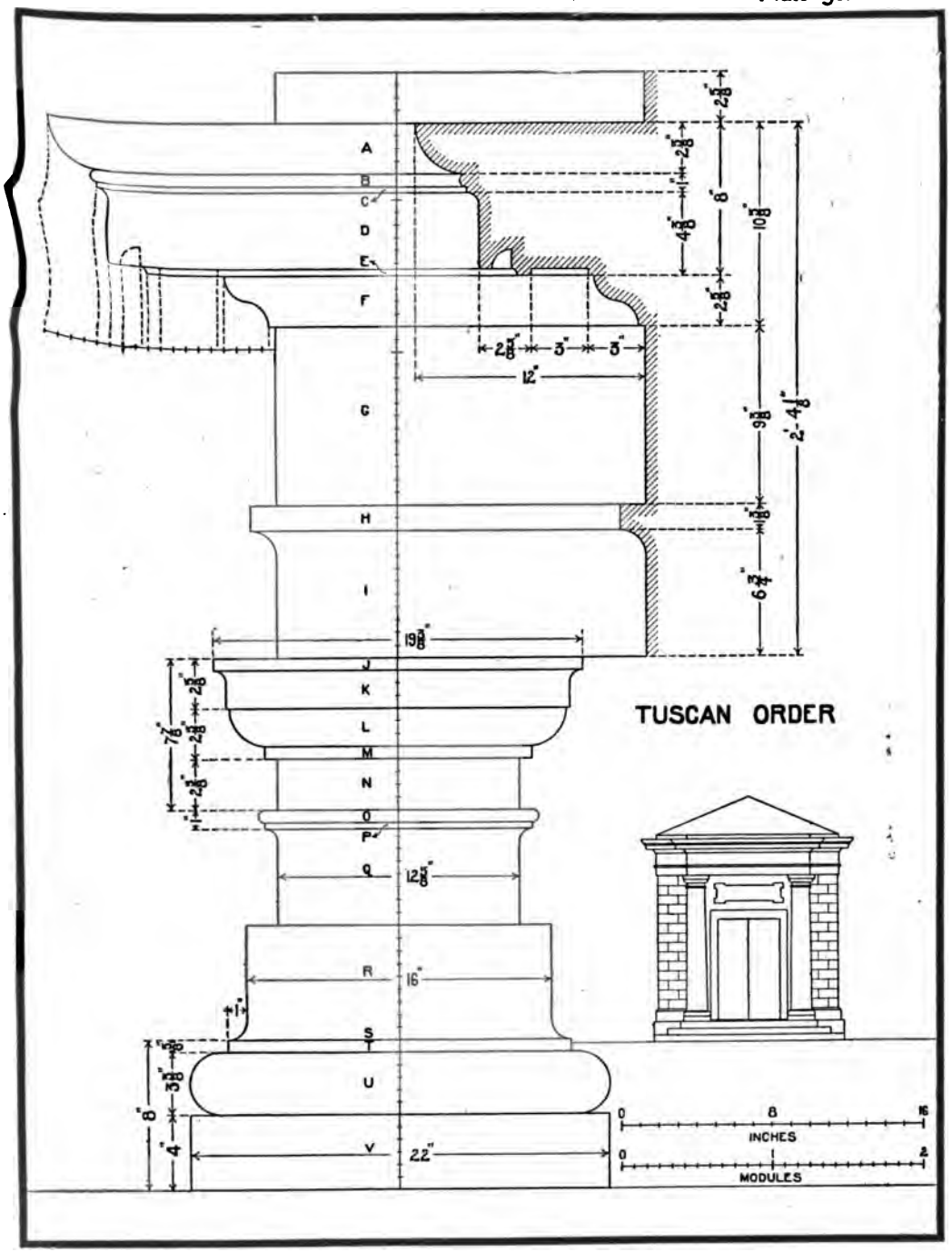
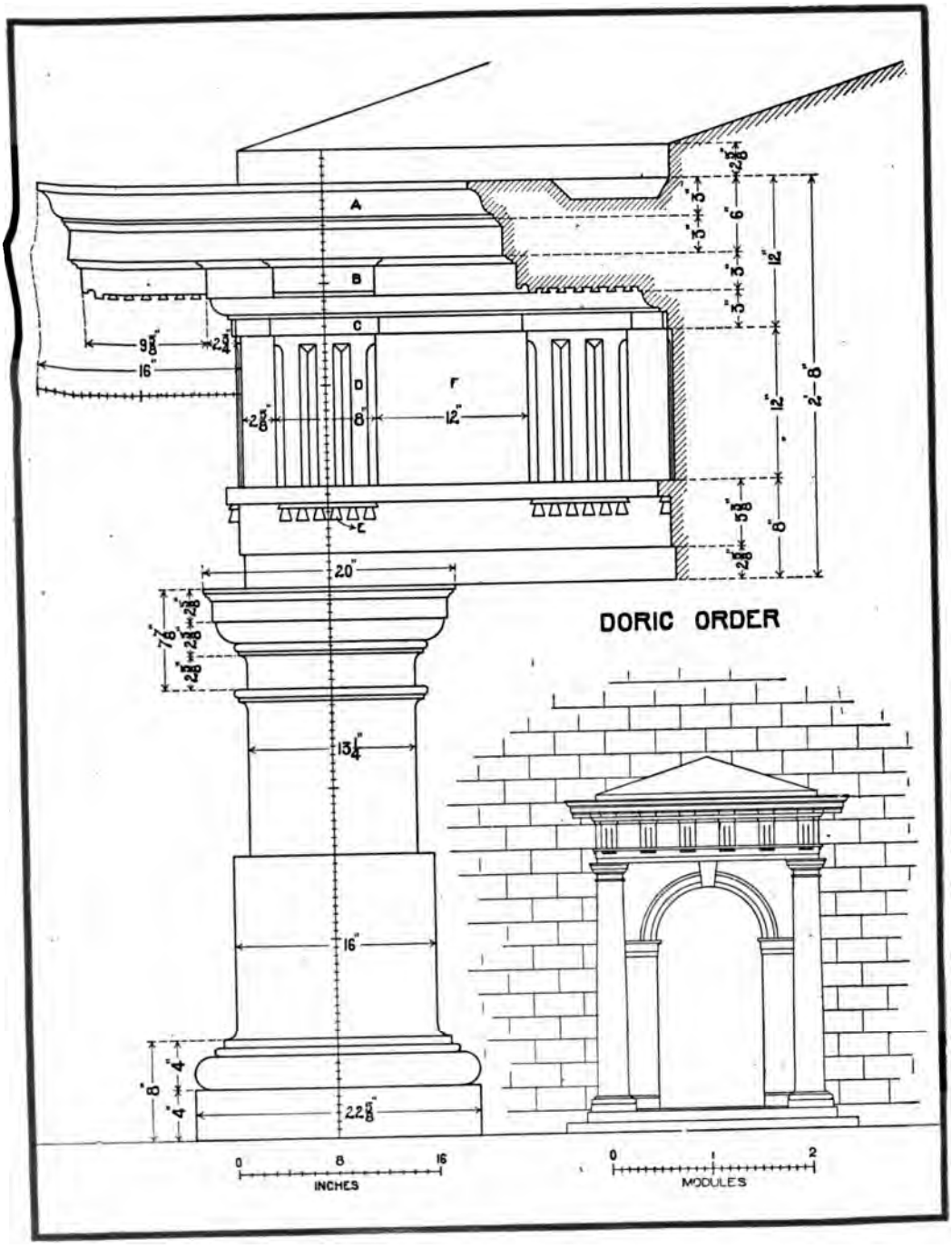

A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
U
V
12"
19 7/8"
12 5/8"
16"
22"
2 5/8"
3"
5"
2' 4 1/8"
9 3/8"
6 3/4"
8"
10 3/8"
4 3/8"
7 5/8"
1 1/2"
3 1/8"
4"
TUSCAN ORDER
0
8
16
INCHES
0
2
MODULES

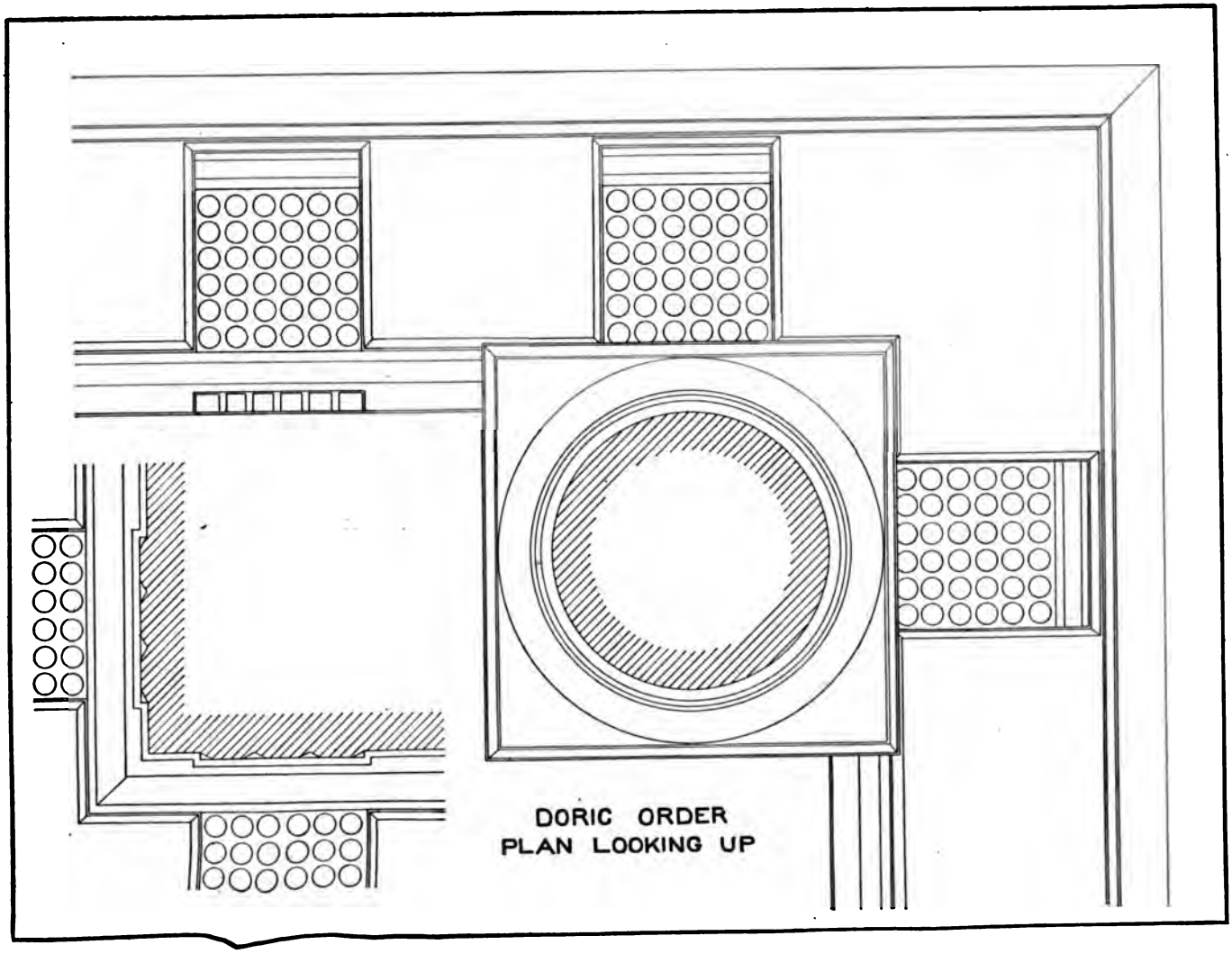
Plate 51.—The drawing in the lower right-hand corner of this plate represents an entrance drawn in the Doric style. That occupying the remainder of the plate is a working drawing of one of the columns and a portion of the entablature. The method of drawing and placing measurements is similar to that carried out in the previous plate.

A—Cymatium or cyma recta.
B—Mutule with drops underneath.
C—Capitals of the triglyphs.
D—Triglyphs with channels.
E—Drops.
F—Metope.

Plate 51.



DORIC ORDER



DORIC ORDER
PLAN LOOKING UP

Plate 53.—This plate presents the working drawing of a window in which the Ionic order is used. The drawing of the window is particularly helpful to the student, in that it shows how to obtain the general effect without drawing all of its details. The enlarged sketch of the volute is given to show the method of construction.

A—Dentils.
B—Volute.
C—Lintel of the volute.
D—Egg.
E—Egg shell.
F—Dart.
G—Pods.

Plate 53.

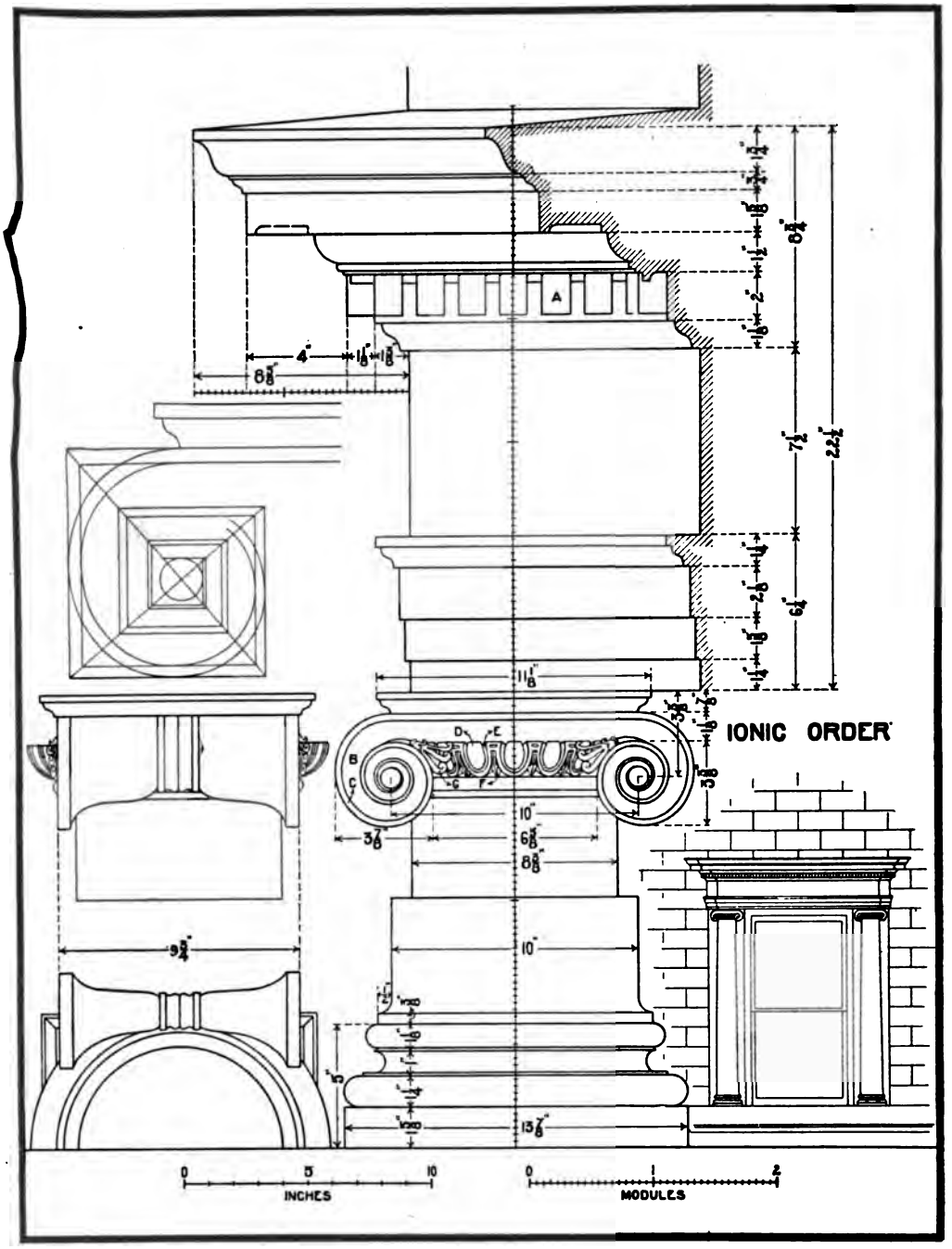


Plate 54.—The drawing at the right represents a porch in which the Corinthian order is used; and that at the left is a working drawing of one of its columns and entablatur

A—Volute.
B—Small stem.
C—Great leaf.
D—Small leaf.
E—Rosette.

Plate 54.

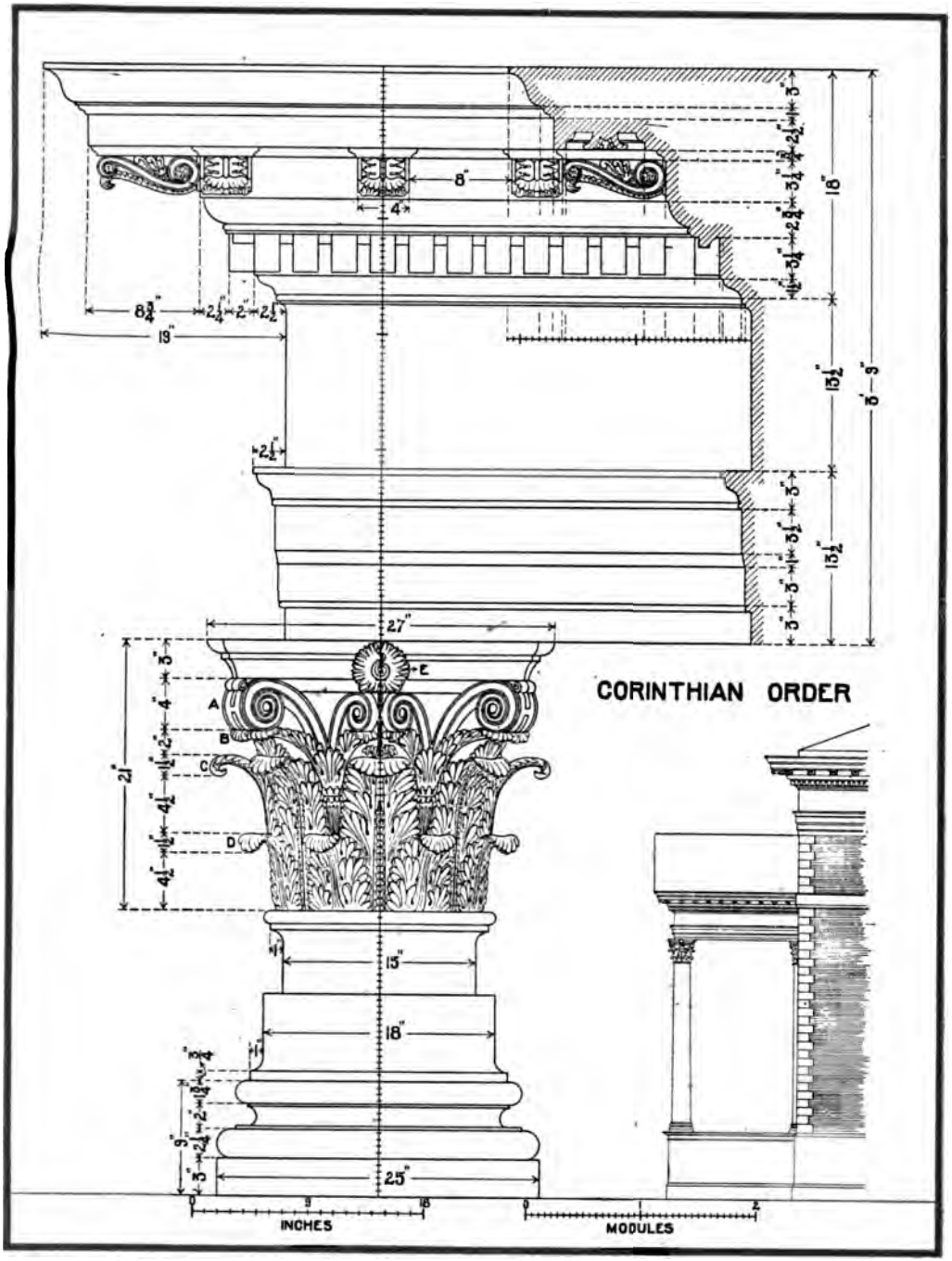
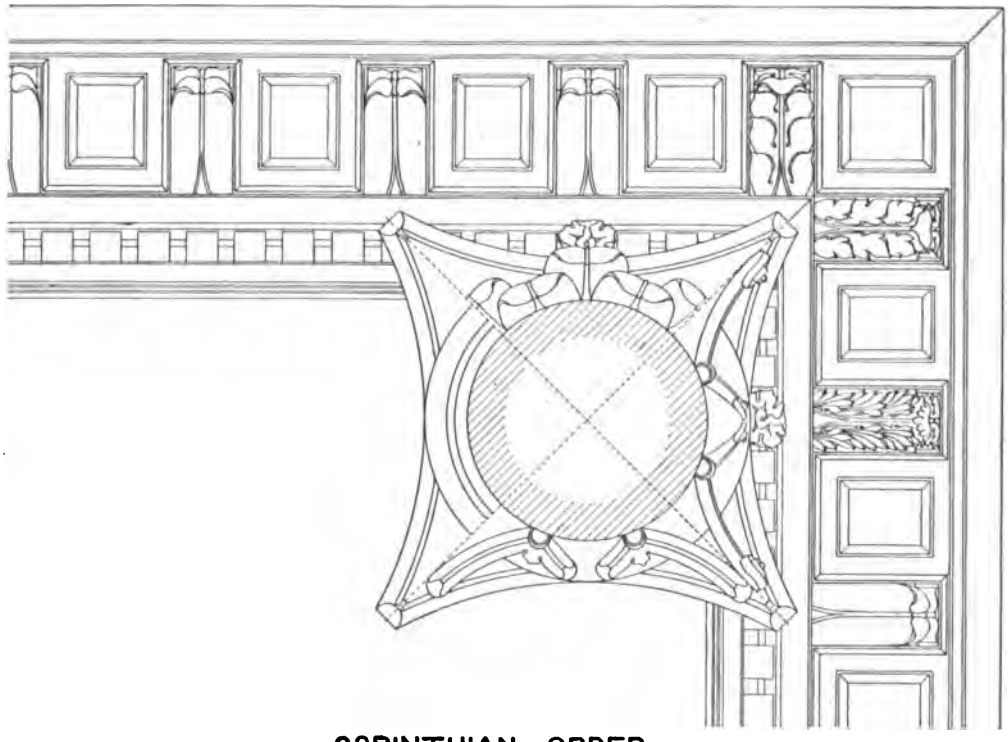
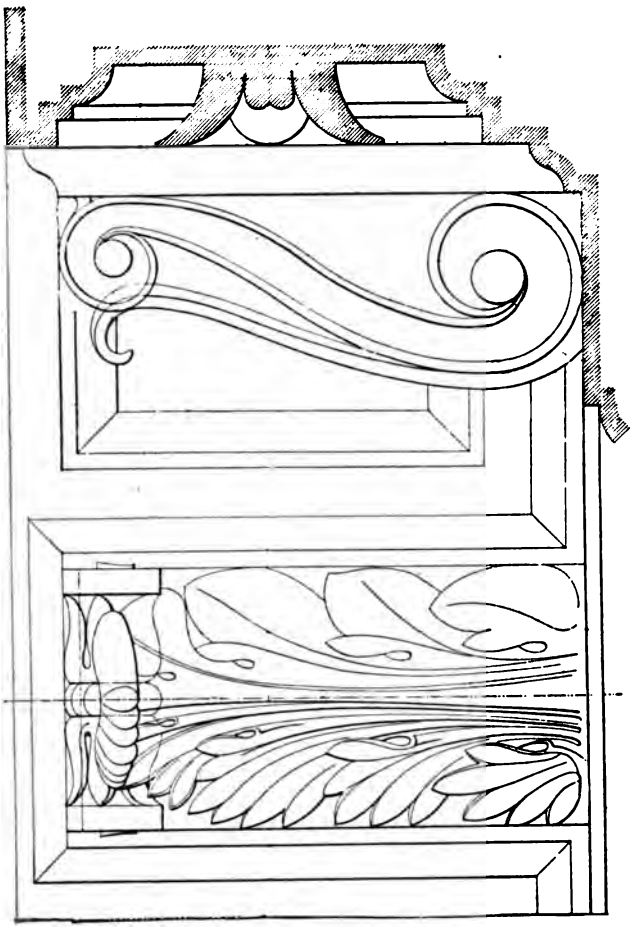


Plate 55.

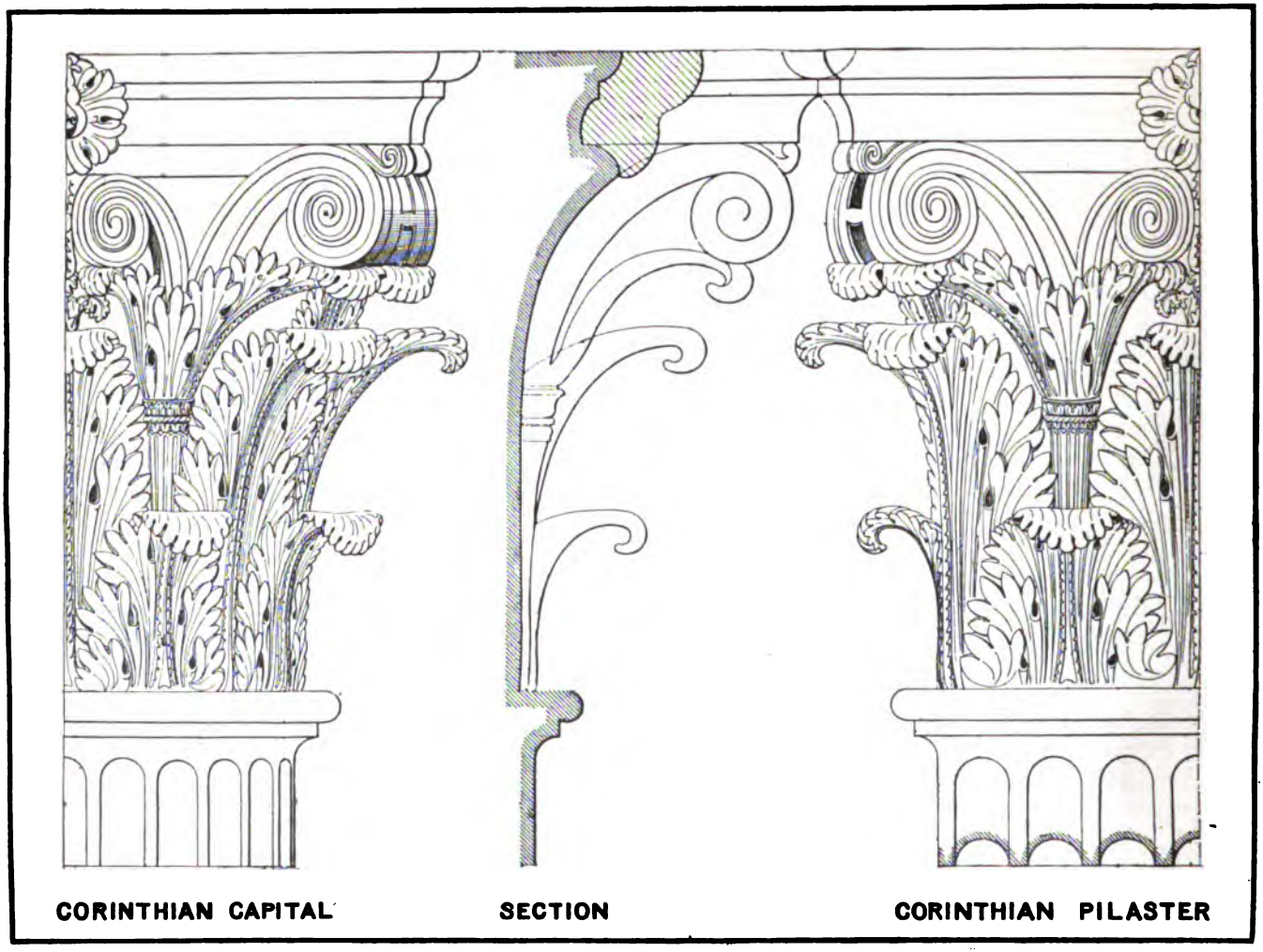


CORINTHIAN ORDER
PLAN LOOKING UP

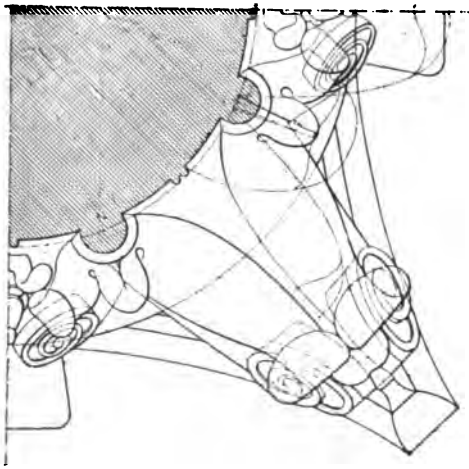


DETAIL OF MODILLION

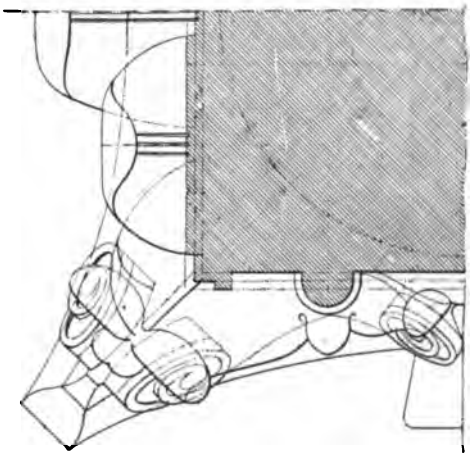
Plate 55 B.



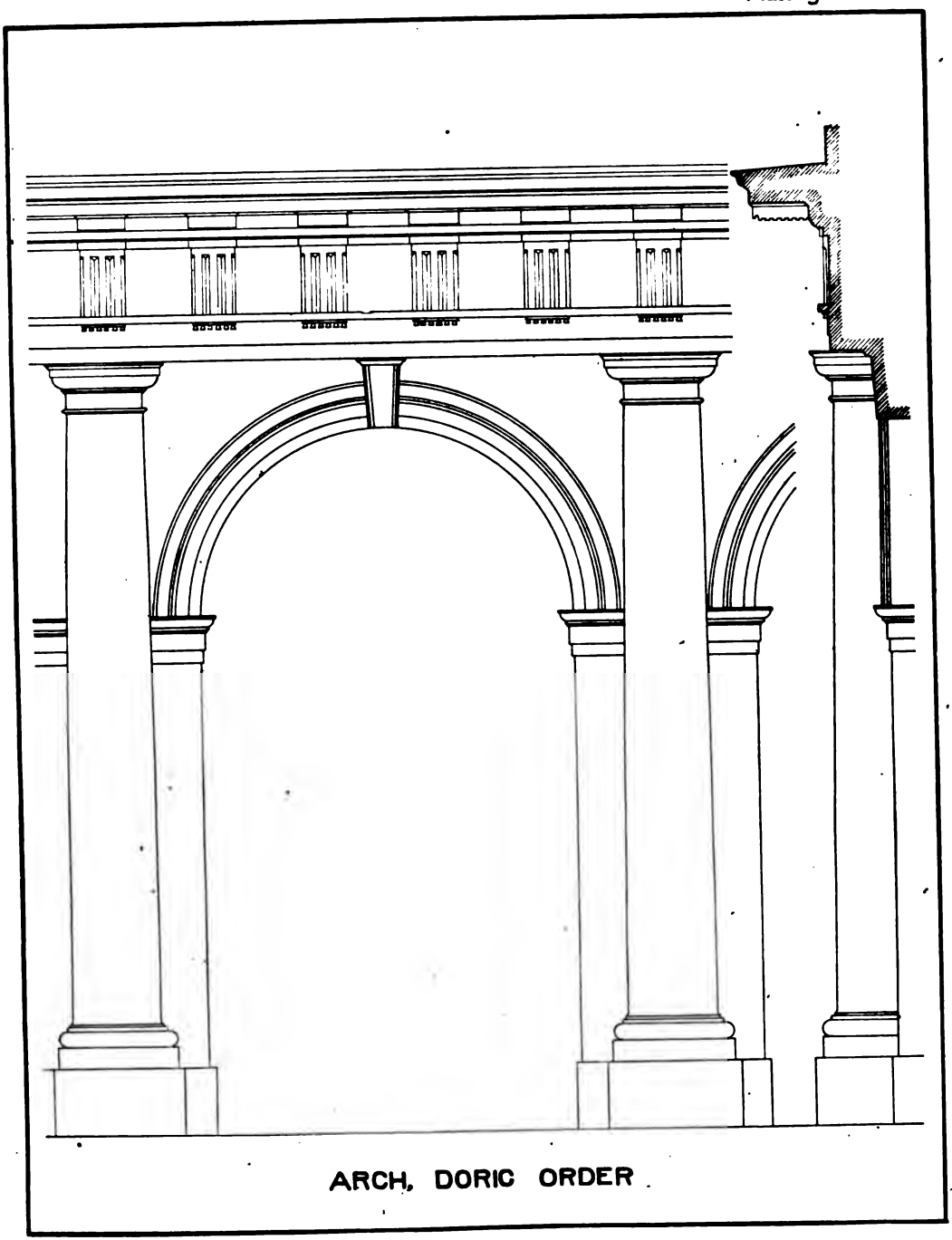
CORINTHIAN CAPITAL SECTION CORINTHIAN PILASTER



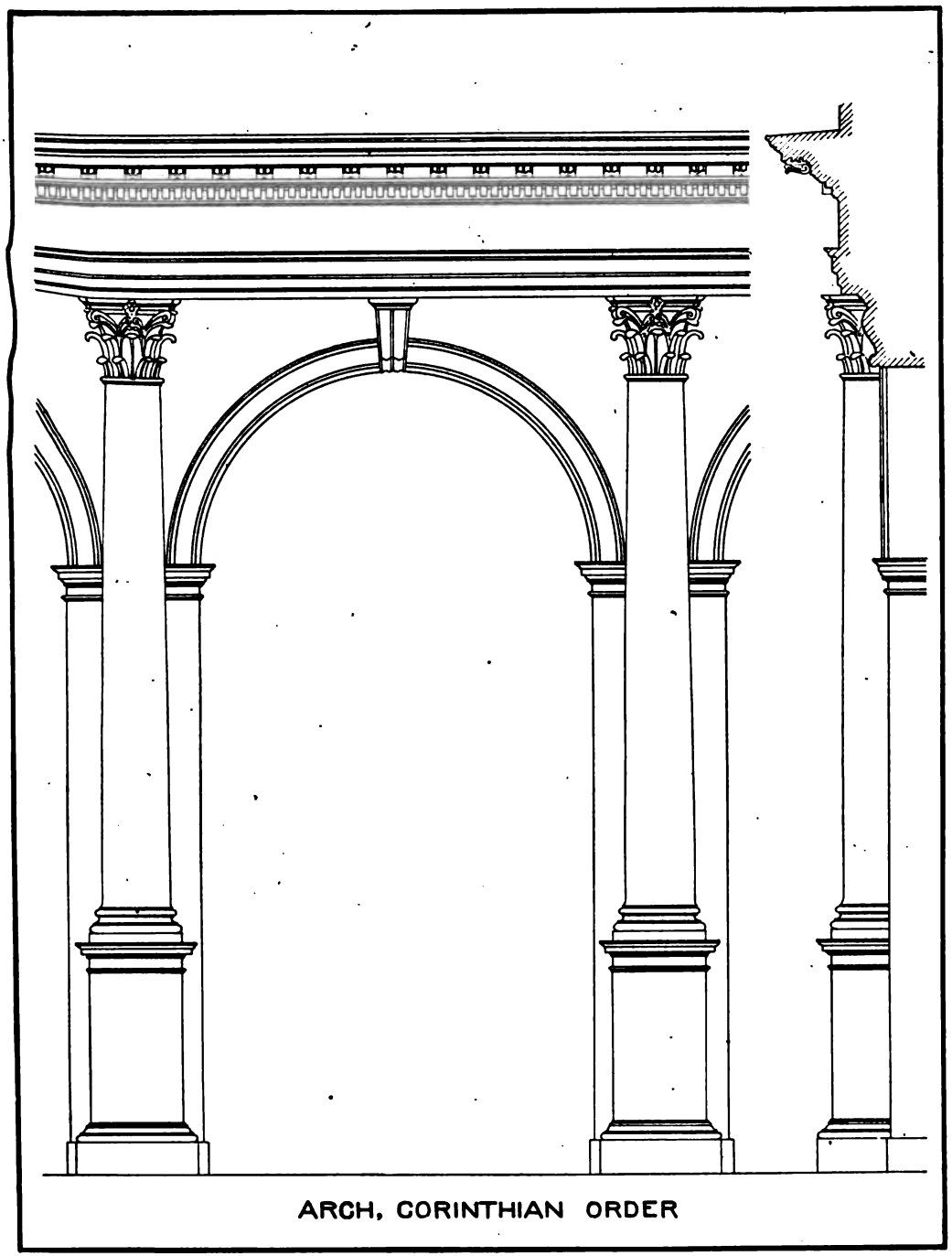
CORINTHIAN CAPITAL
PLAN LOOKING UP



CORINTHIAN PILASTER
PLAN LOOKING UP



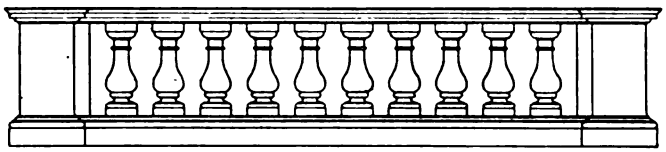
ARCH, DORIC ORDER.

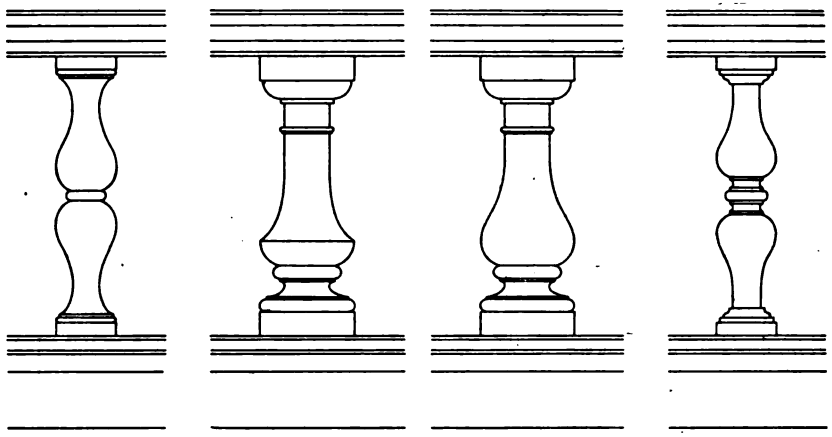


ARCH, CORINTHIAN ORDER

Plate 58.—This sheet presents several forms of balusters in general use. A greater benefit will be derived by making the drawings much larger than in this plate.

BALUSTRADES





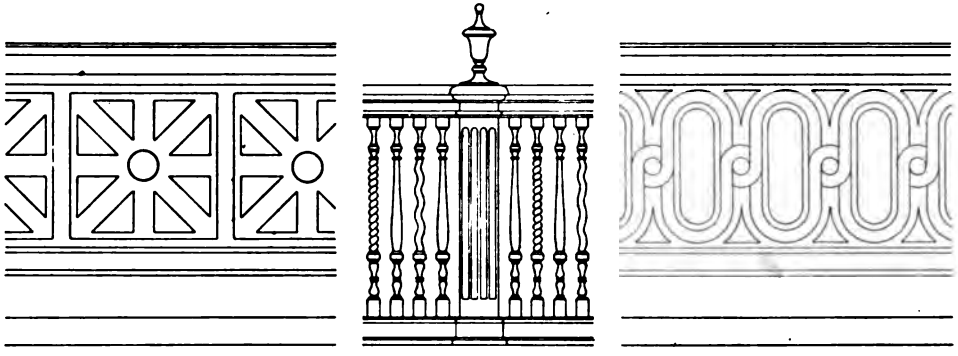
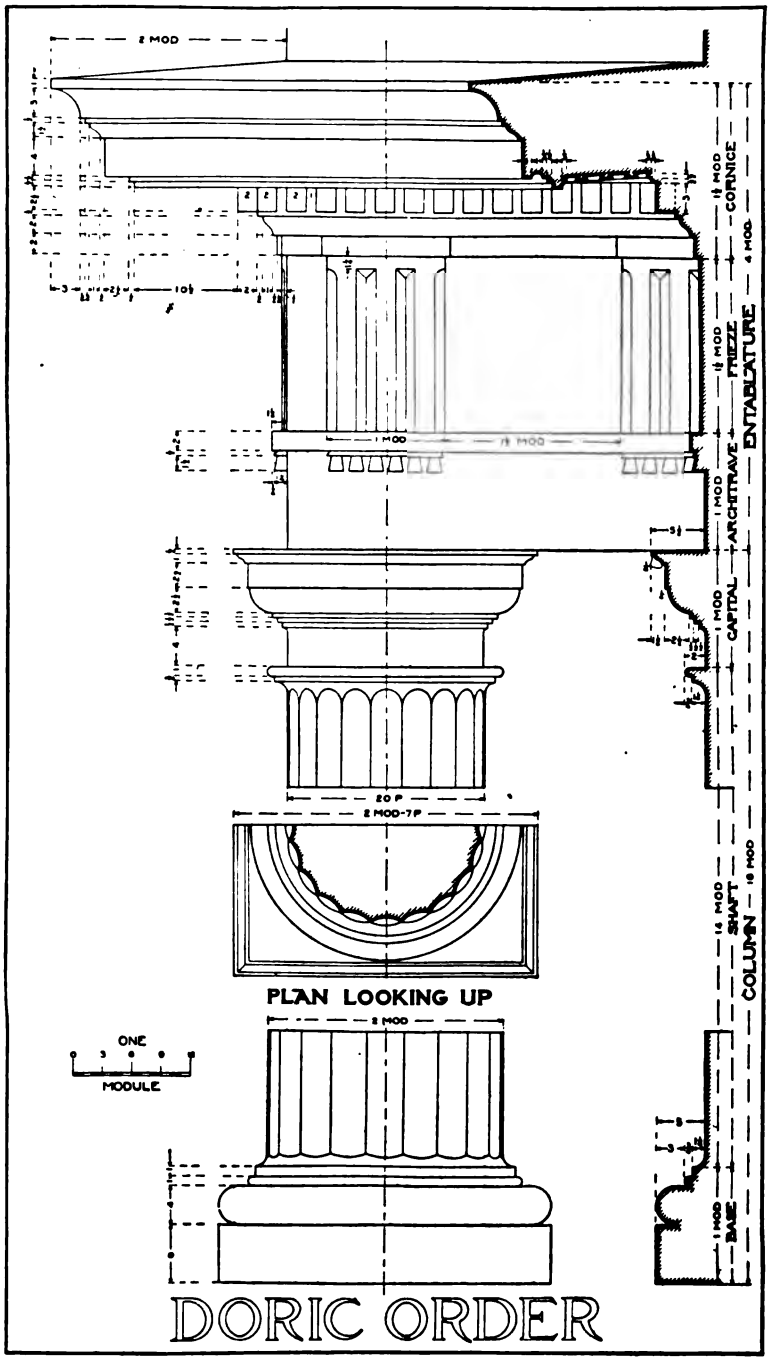
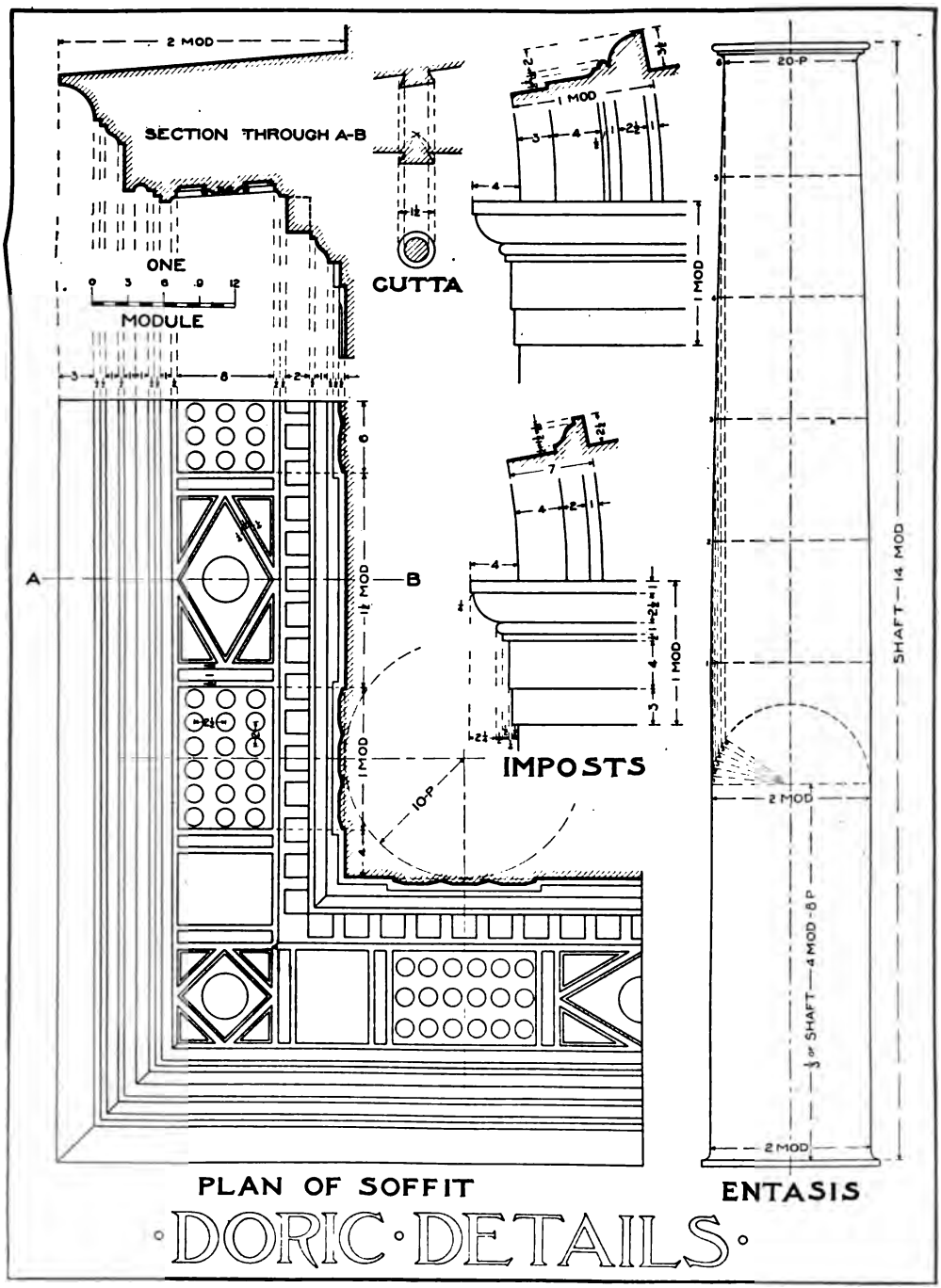


Plate 58A.


2 MOD
CORNICE
FRIEZE
ARCHITRAVE
ENTABLATURE
CAPITAL
SHAFT
COLUMN
BASE
PLAN LOOKING UP
ONE
MODULE
DORIC ORDER



DORIC DETAILS

Plate 58C.

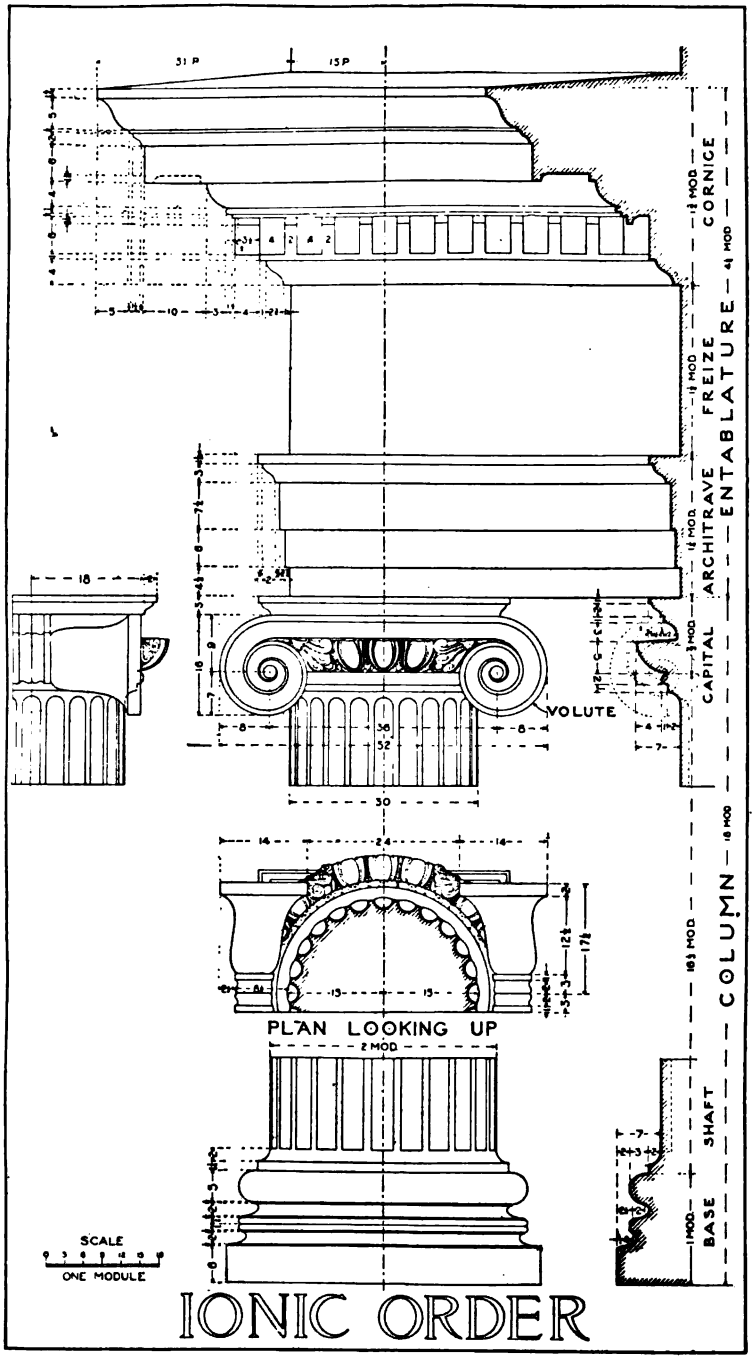

31 P
15 P
CORNICE
FREIZE
ARCHITRAVE
CAPITAL
ENTABLATURE
COLUMN
VOLUTE
PLAN LOOKING UP
BASE
SHAFT
SCALE
ONE MODULE
IONIC ORDER

Plate 58D.

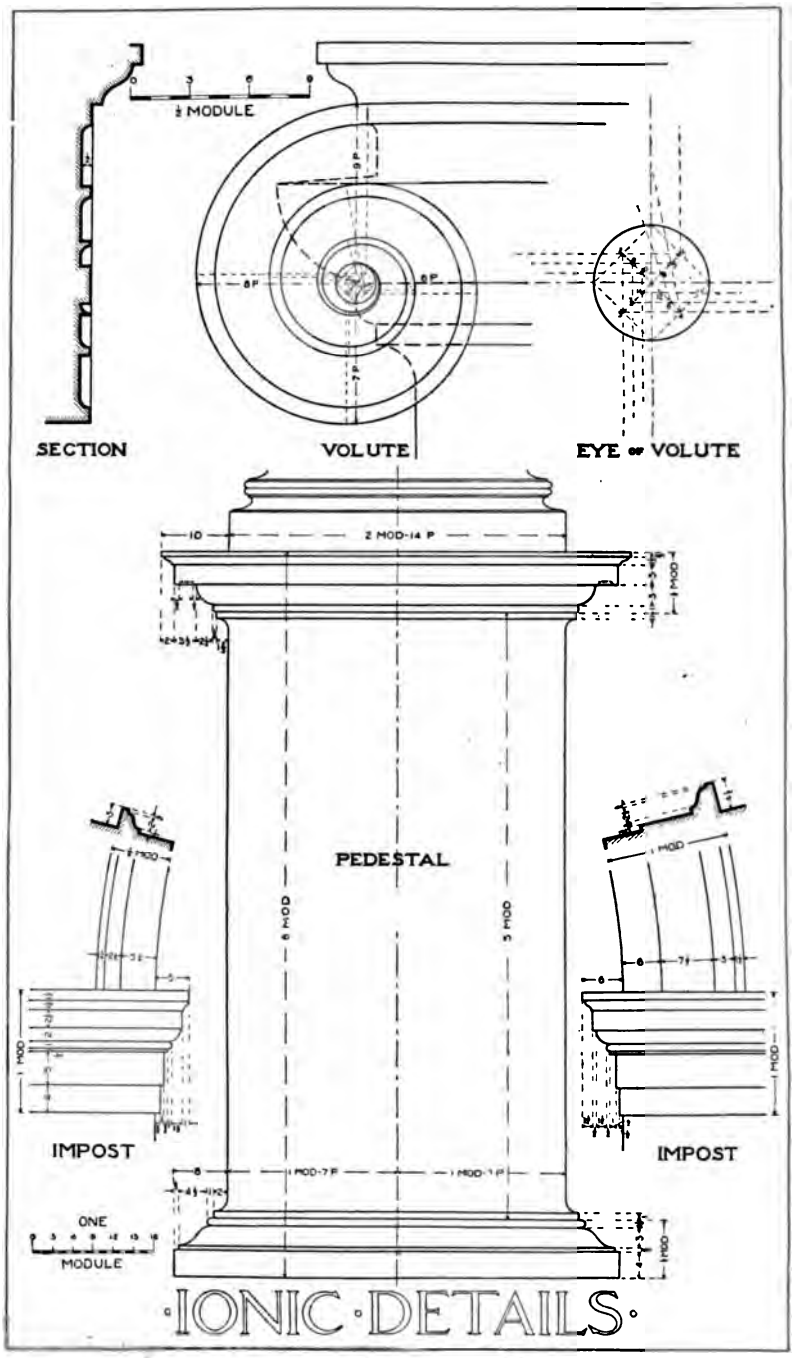
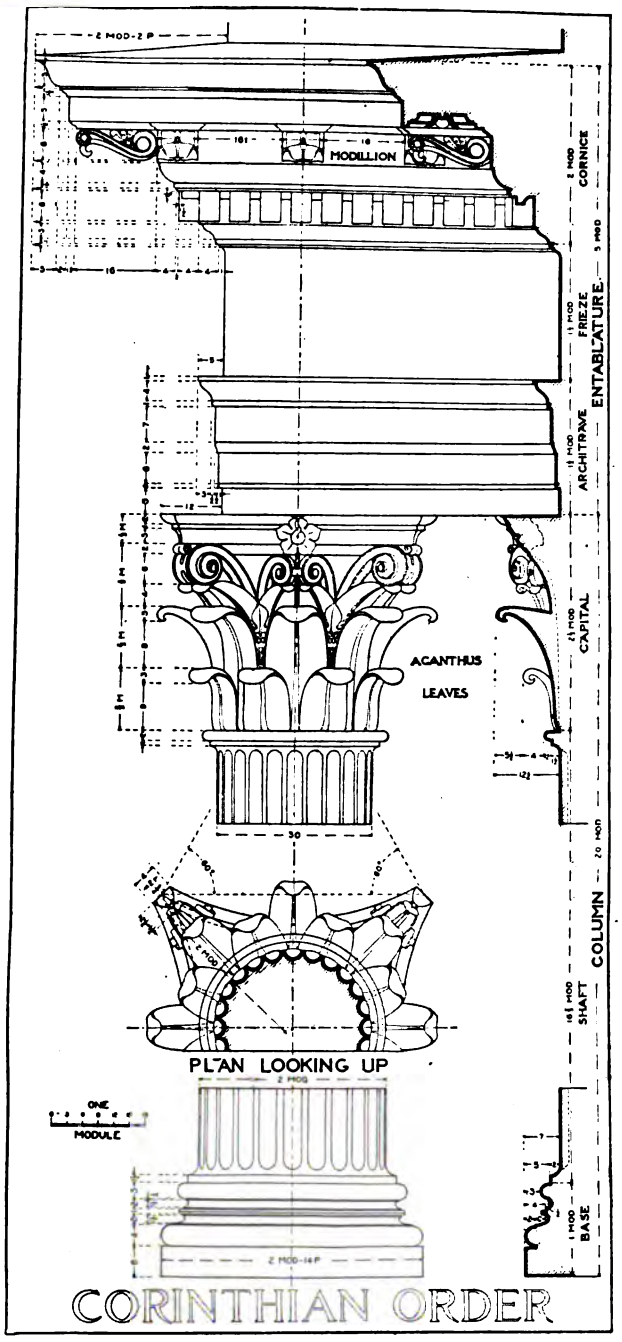
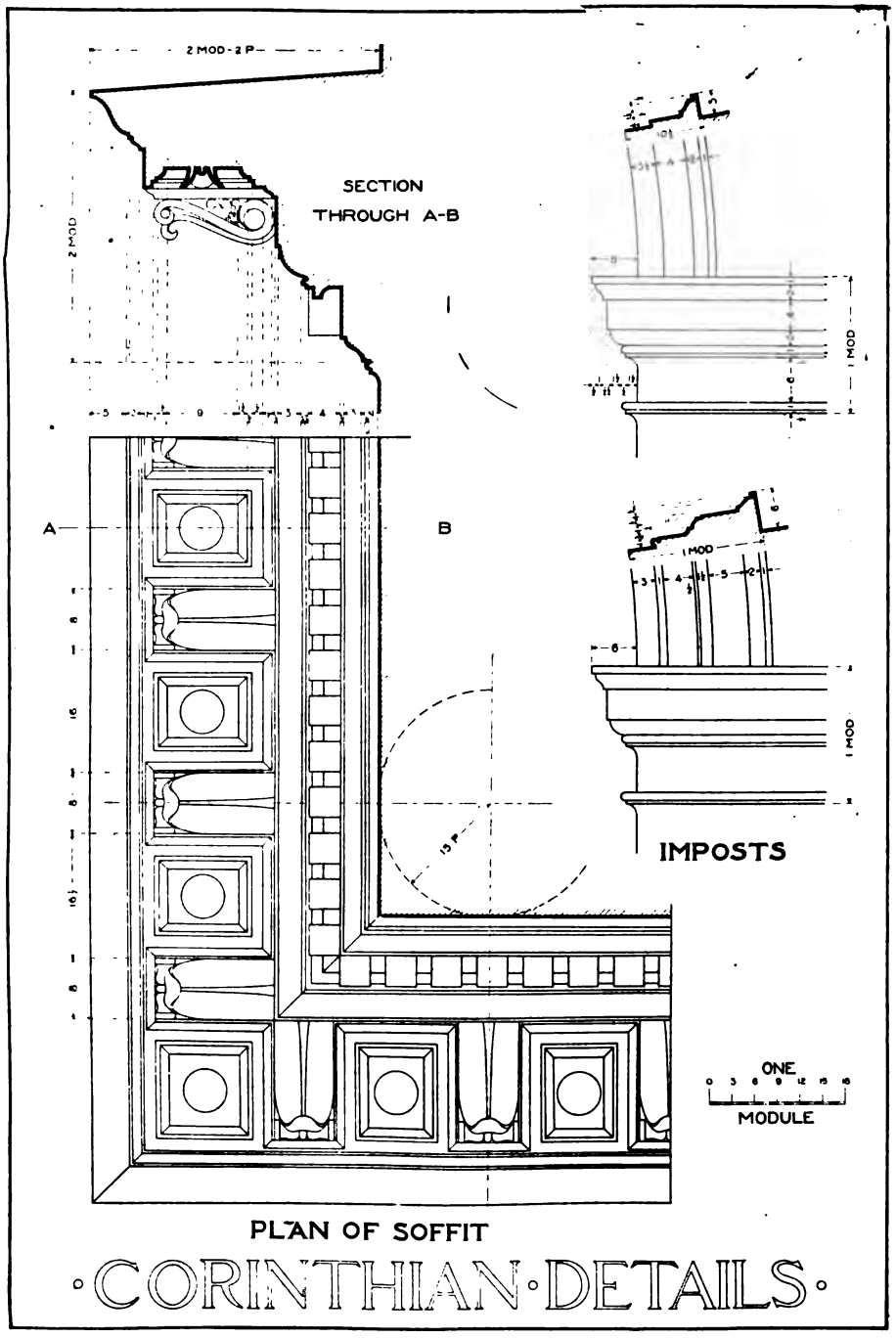

½ MODULE
SECTION
VOLUTE
EYE OF VOLUTE
2 MOD-14 P
1 MOD
PEDESTAL
6 MOD
3 MOD
IMPOST
IMPOST
ONE
MODULE
IONIC DETAILS

Plate 58E.



CORINTHIAN ORDER

Plate 58F.



CORINTHIAN DETAILS

Plate 59.—This sheet represents several typical mouldings drawn in section and elevation. In order to secure beautiful profiles upon mouldings, they should be drawn freehand. The surfaces of the mouldings may be rendered with India ink, as shown in the plate.

Plate 59.

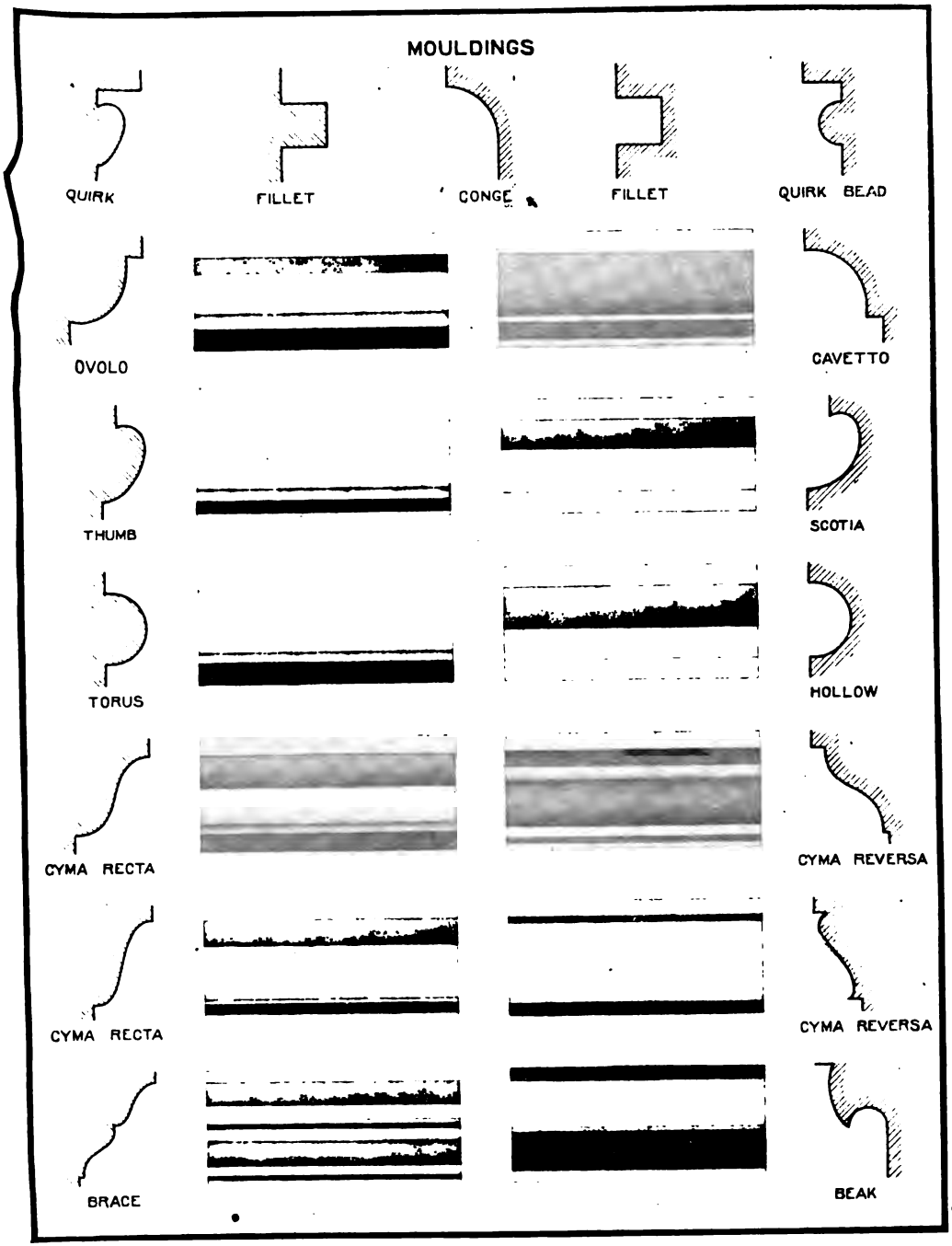

MOULDINGS
QUIRK
FILLET
CONGE
FILLET
QUIRK BEAD
OVOLO
CAVETTO
THUMB
SCOTIA
TORUS
HOLLOW
CYMA RECTA
CYMA REVERSA
CYMA RECTA
CYMA REVERSA
BRACE
BEAK

Plate 60.—This and the five following plates are reproduced from drawings made by students of the French school of architecture. They are given in this series to supplement the orders and will be particularly helpful in rendering. The student should note the skillful draughtsmanship with which these plates are drawn and the excellent printing upon them.

Plate 61.

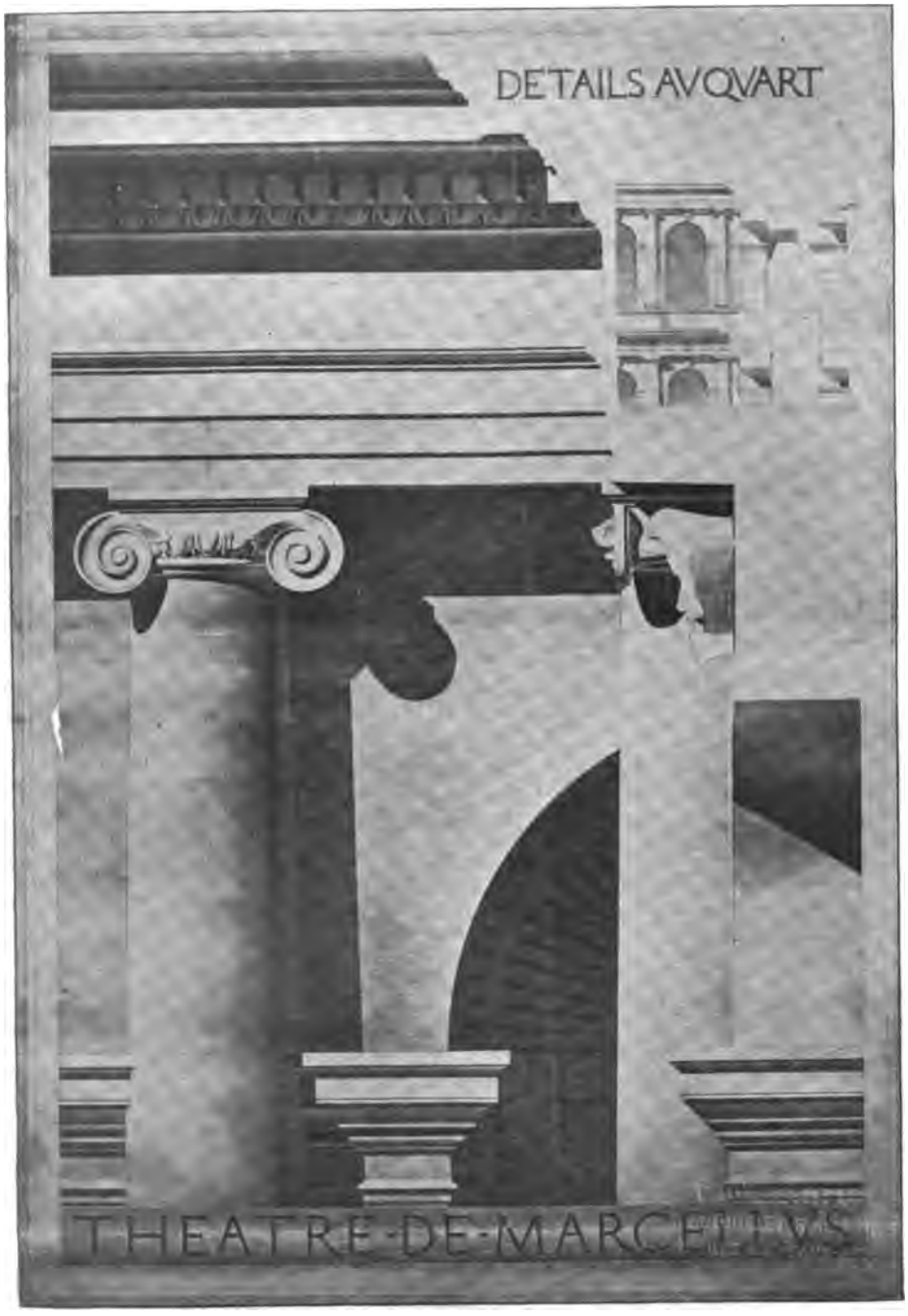


Plate 62.

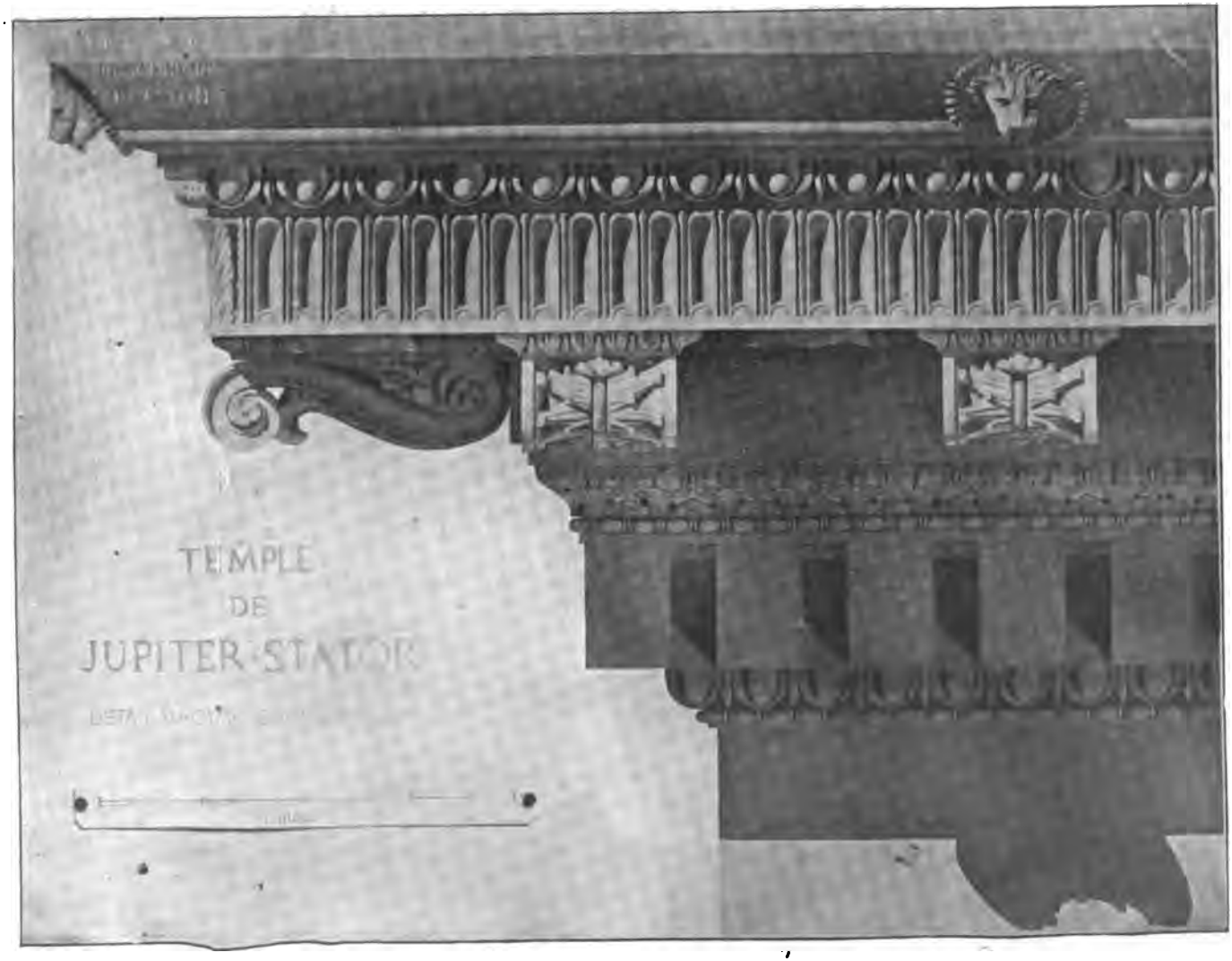
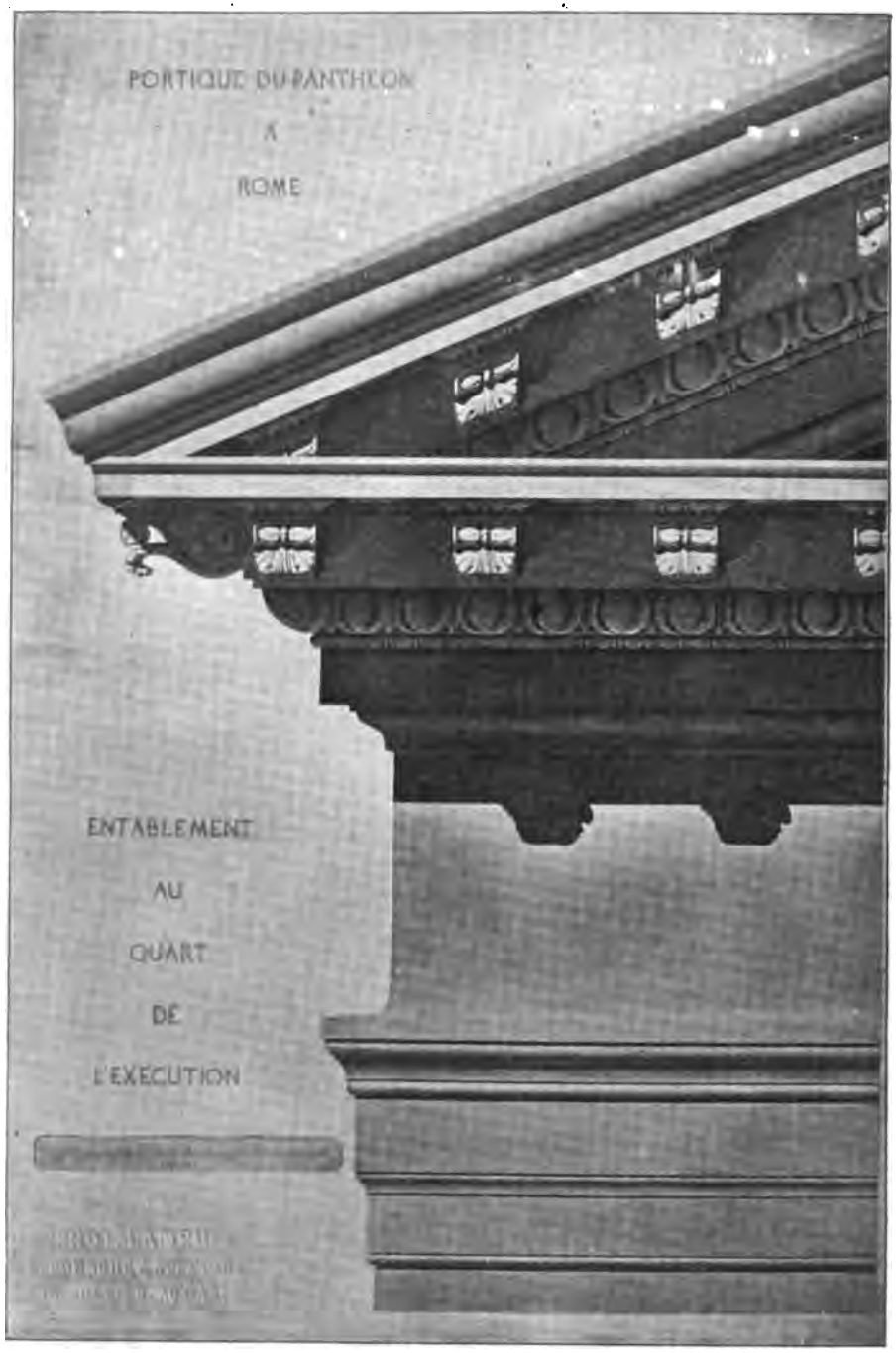

TEMPLE
DE
JUPITER STATOR

Plate 64.

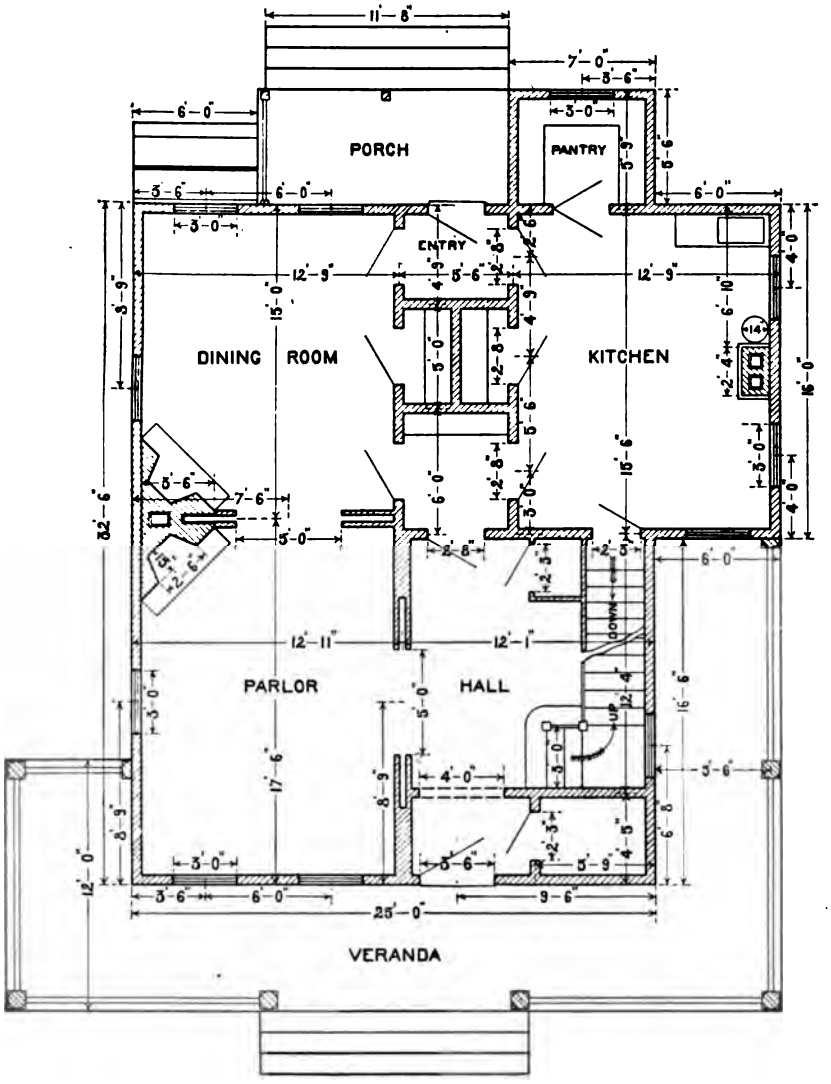

PORTIQUE DU PANTHEON
A
ROME
ENTABLEMENT
AU
QUART
DE
L'EXECUTION

CHAPTER VIII.

STUDY OF A FRAME HOUSE.

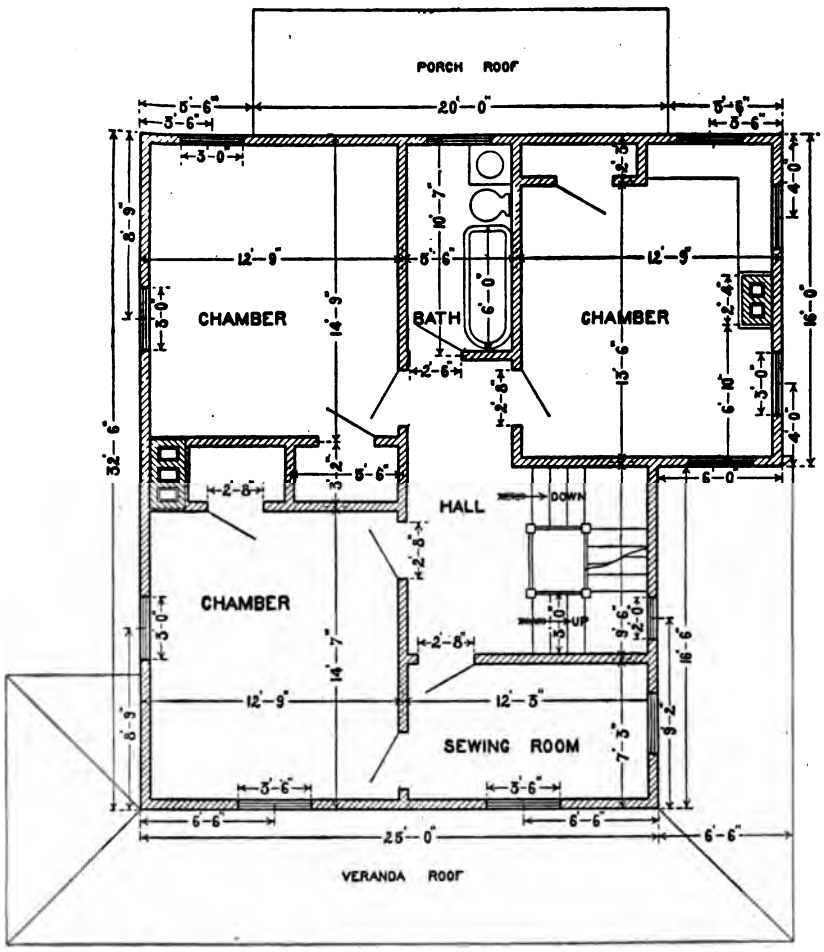
Plate 66.—With this plate we begin the study of a series of drawings showing plans, elevations, framing and various details of a wooden building.

A plan is nothing more nor less than a horizontal section passing through the walls and partitions a few feet above the floor, showing the interior arrangements. The student should note the conventional method of representing its various parts, such as the veranda, outside and inside doors, windows, stairs, chimneys, etc. Portions of two flights of stairs are shown in this plan, one leading to the second floor and the other to the cellar. In the plan only the treads are visible, the risers being covered by lines which are the boundary lines of the treads. To obtain an easy flight of stairs, the riser should bear a certain relationship to the tread; that is, if we have a very wide tread the riser should be low, or if by necessity the tread is narrow, the riser should be proportionally high. A rule that is used to some extent is that the rise multiplied by the tread should be about seventy or seventy-five inches. Fire-places are shown in both parlor and dining-room. The oblong space in the masonry between the fire-places represents the flue which connects with the furnace in the cellar. The inner lines of the flues represent the linings, which are of terra-cotta. The flue for a fire-place will never appear on the same plan with it, but is shown in that of the floor above. The two doors leading from the parlor are made to slide, all others to swing in the direction indicated by the single line. The walls and partitions through which the section passes should be tinted with a light wash of burnt sienna or some similar color. The brickwork of the chimney may be colored light red. Section lining as shown in the drawing is seldom used in practice; only in reproductive work.



FIRST FLOOR PLAN

Plate 67.—In this plan, as in the one preceding, the section is taken some distance above the floor. Were the paper of sufficient size the two plans would be made side by side, in which case many of the principal lines might be projected directly from the first floor plan, saving the trouble of repeating measurements. All the principal parts are represented in the same conventional way as in the first floor, the chimney flues being nearly over those of the first floor. Parts of two flights of stairs are shown in this plan; that leading downward to the first floor being the complement of the portion seen in the first floor plan, and the other leading to the attic.

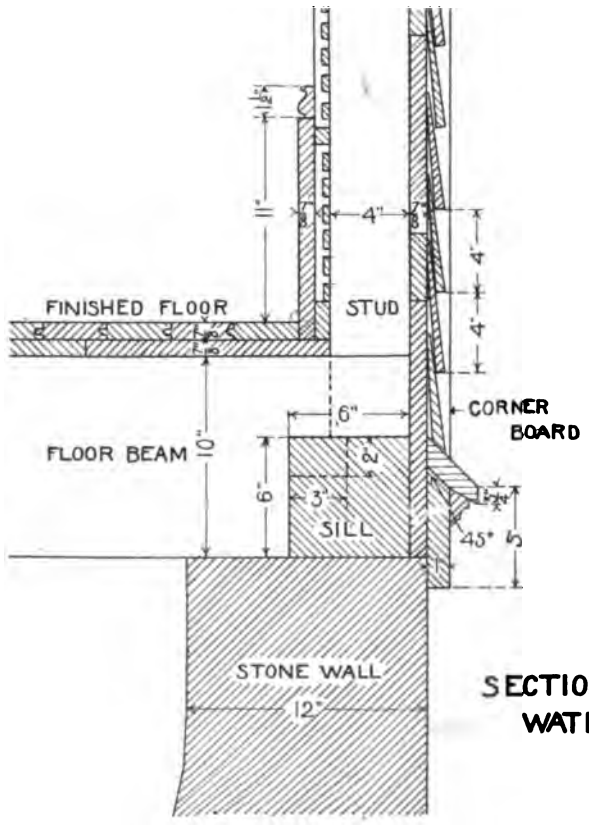


SECOND FLOOR PLAN

Plate 68.—The detail at the left represents a vertical section of the water table, passing through the foundation and a portion of the building above the sill.

In making a detail drawing, it is always best to begin with some fixed part; in this case with the foundation, sill, floor beam and stud. Having fixed the framework in its position, we next clothe it; that is, on the outside place the sheathing, water table, clapboards and corner board, and on the inside, draw the under flooring, lath and plaster, baseboard, and finally, the finished floor. The order given is similar to that followed in actual construction.

The drawing on the right side of the plate represents the elevation of this section. All horizontal lines may be projected directly from the section to the elevation; and, as will be seen, the members in both section and elevation project the same distance from the body of the house. The woodwork should be tinted with a light wash of burnt sienna, and the stonework may be covered with a very pale wash of blue.



SECTION THROUGH WATER-TABLE

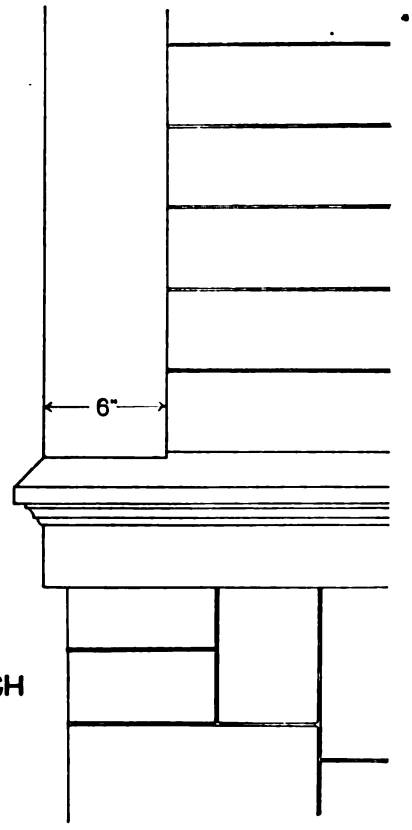
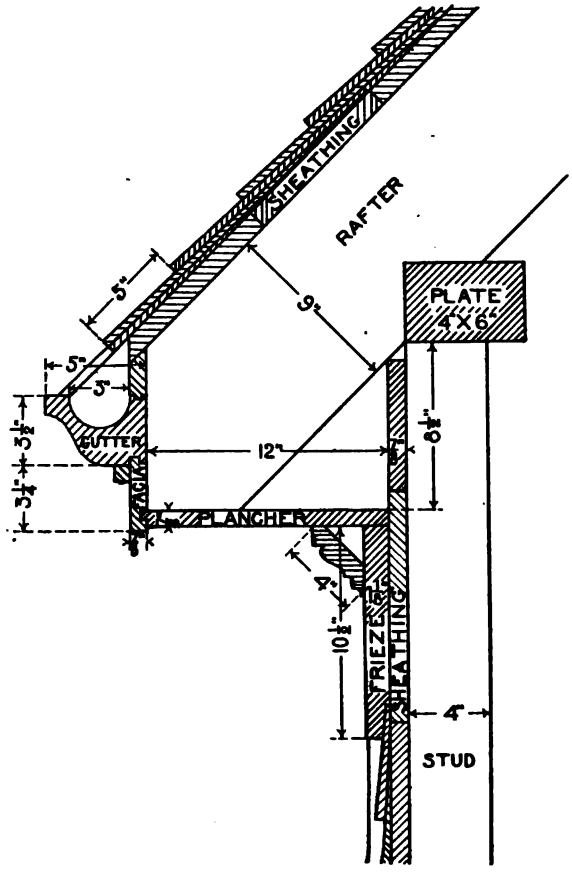
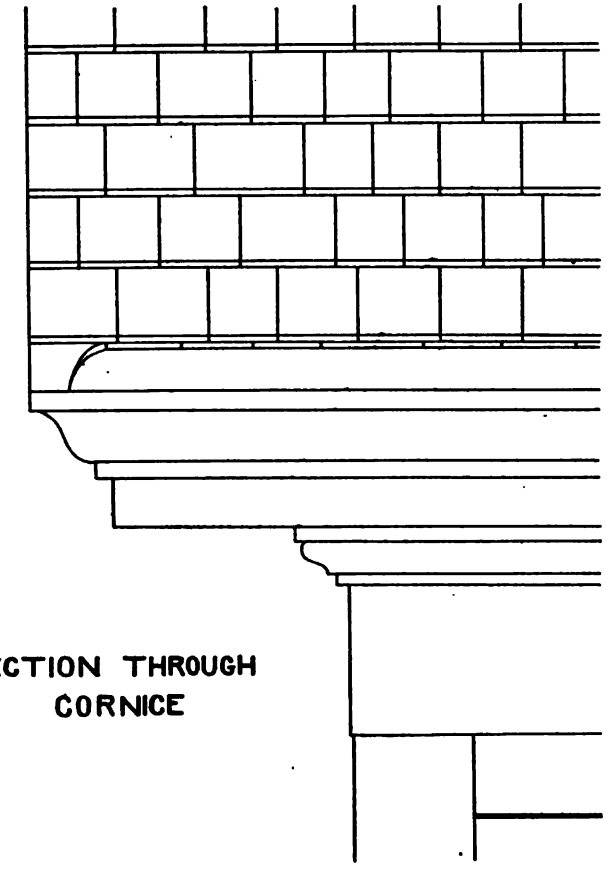


Plate 69.—To draw this plate we proceed as in the last, beginning with the framework, drawing first the stud and then placing the plate and rafter, cutting it to the desired shape to fit the trim. Complete the details as given in drawing. The shingles on the roof are 18″ long and show 5″ to the weather, their widths varying as shown in the elevation.

The drawing at the right represents the elevation, and in this, as in the last plate, vertical measurements can be obtained by projecting horizontal lines from the section. The offsets in the section and elevation are equal.

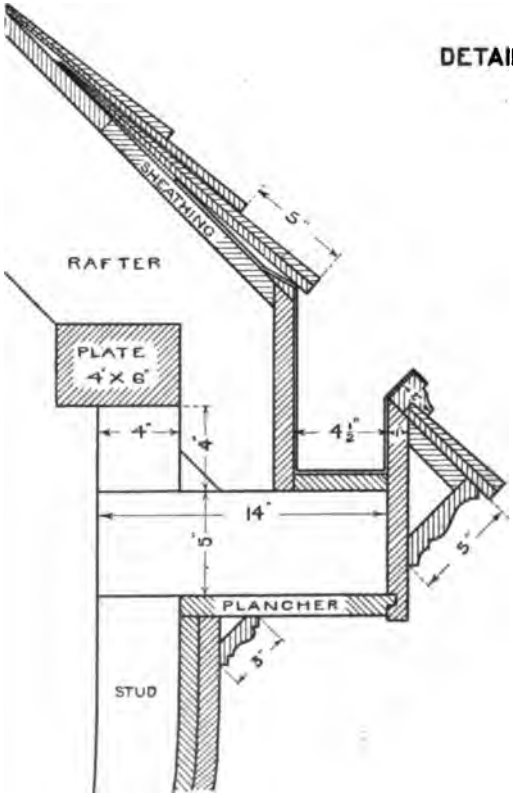




SECTION THROUGH CORNICE

Plate 70.—The two sections given upon this plate represent cornices differing in form from that in Plate 69. The one on the left shows the gutter built into the roof in such a way as not to be noticeable from the street. This form of gutter is built up with boards and lined with some kind of metal, usually copper, sheet lead, or tin. The metal should be allowed to run up under the shingle for some distance. The section on the right shows the construction of a cornice suitable for a curved roof. The method of constructing the gutter in this case is similar to the first, differing only in minor details.

DETAIL OF CORNICES



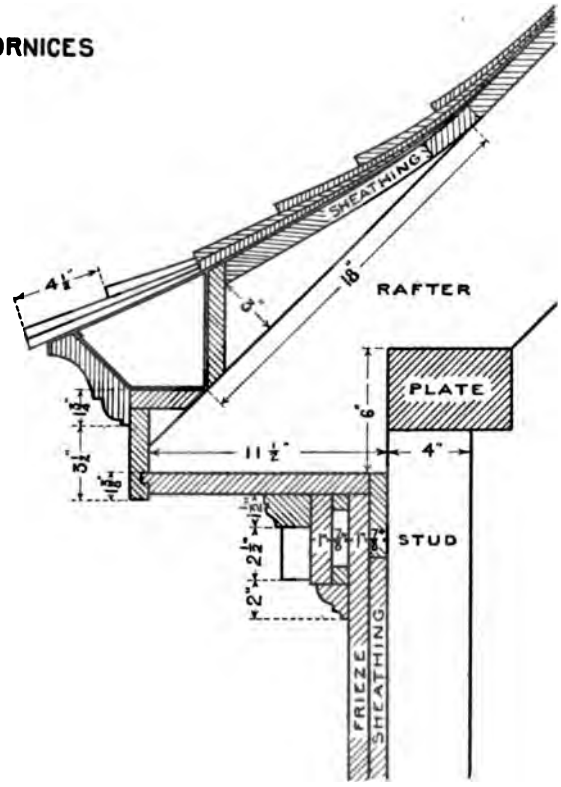
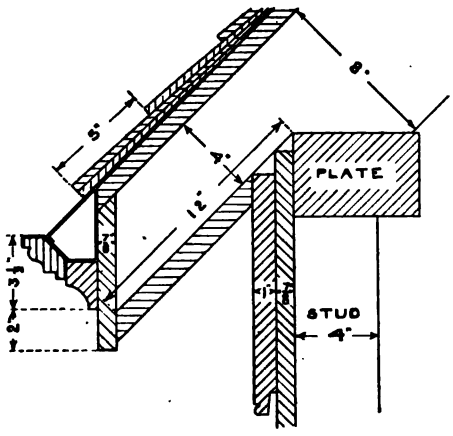
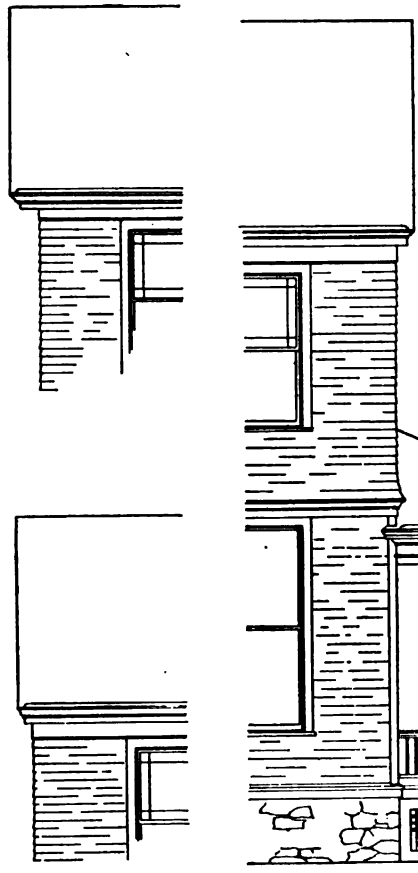


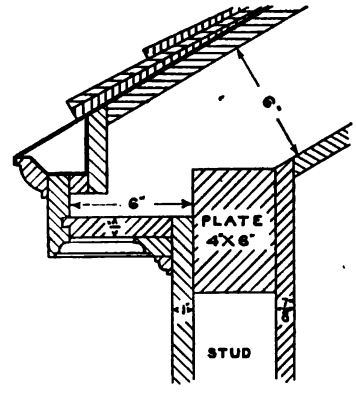
Plate 71.—This plate shows still other forms of constructing the cornice and their appearance when drawn to a small scale. This is intended especially for a suggestive sheet, to assist the student when designing.

In the three plates of cornice designs given, the draughtsman can get an idea of the types in general use, and with this knowledge he will be able to vary the details as may best suit his design.

DETAIL OF CORNICES







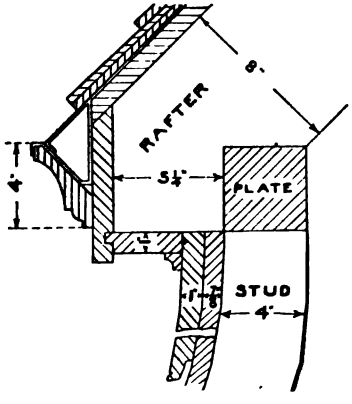


Plate 72.—This drawing represents a vertical section passing through the veranda cornice, showing the various parts in their relative positions. It should be drawn as nearly full size as possible. After placing the column, locate the cornice and the foundation according to measurements given. The column is supported by the sill, and also by the girder which joins the sill directly under the column.

Plate 72.

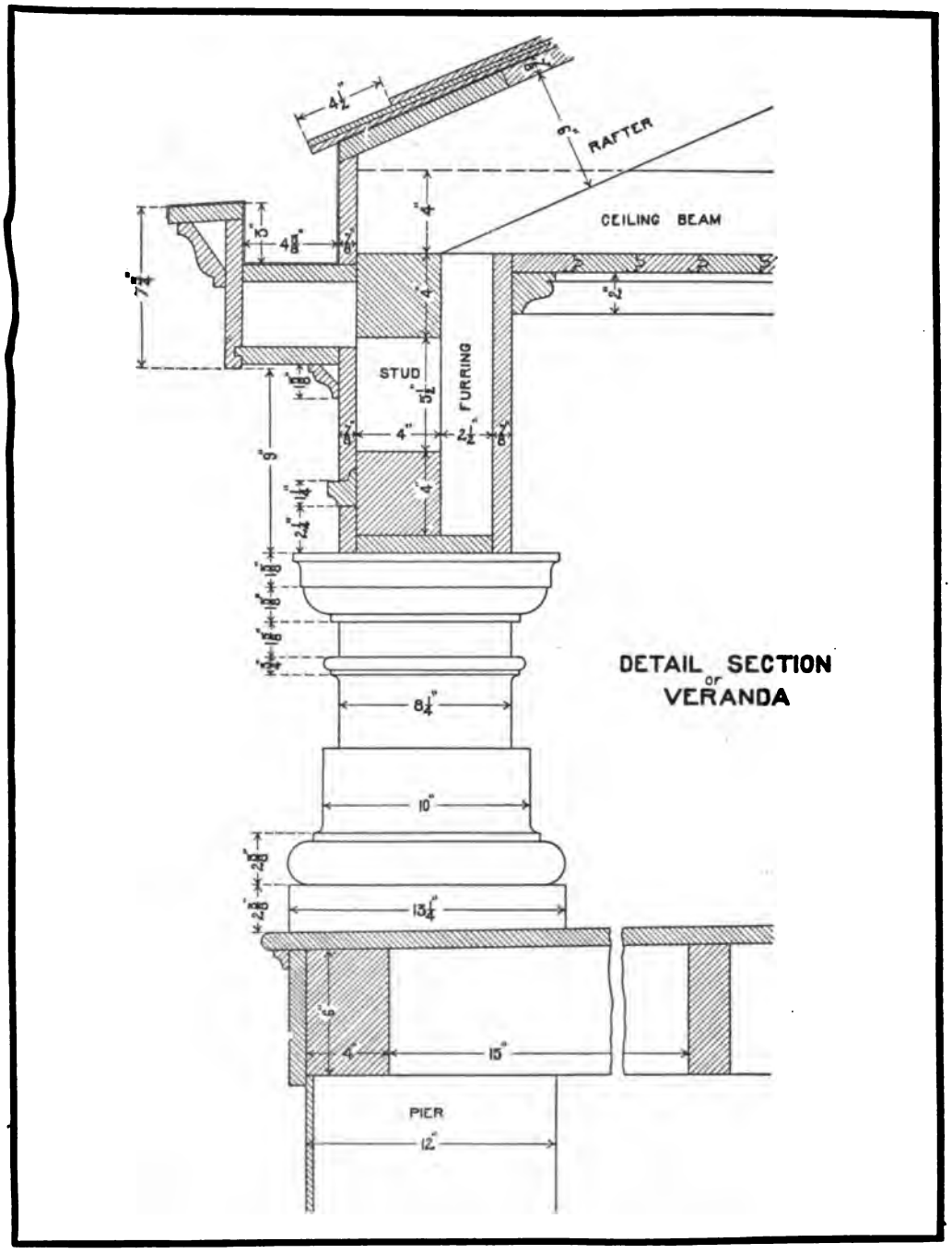
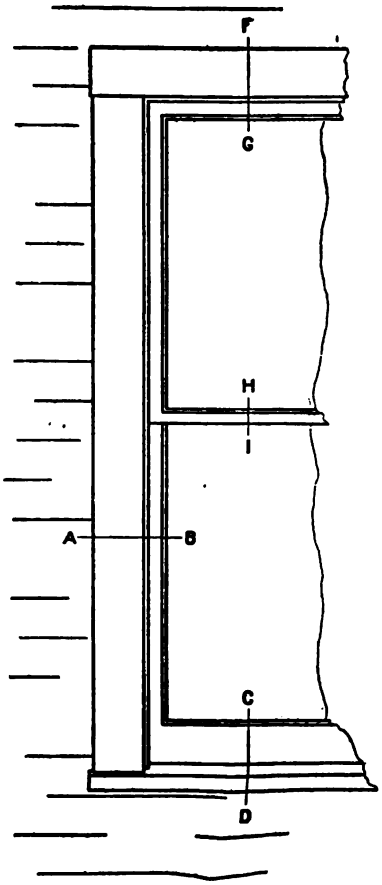
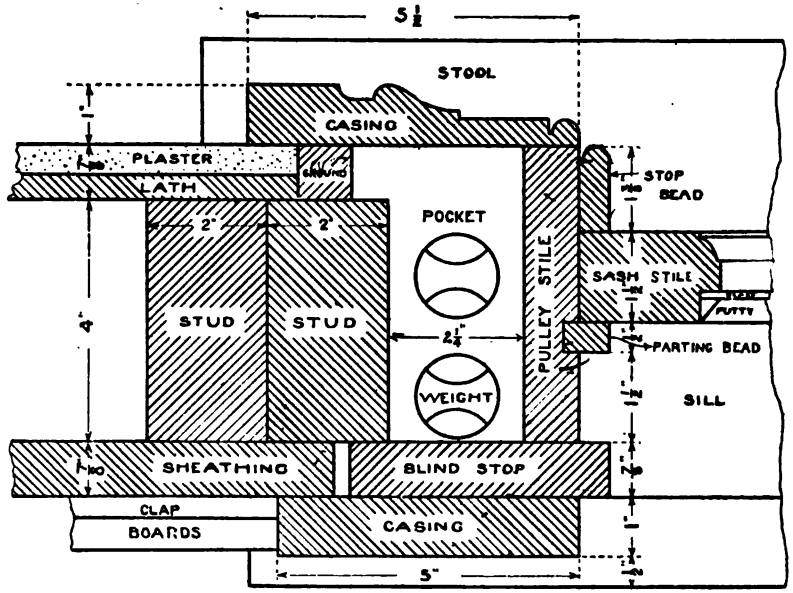


Plate 73.—The drawing on the left of the plate represents a portion of the elevation of a window. The drawing on the right is a horizontal section of a window frame. In this, first draw the studs, after which place the sheathing, laths and plaster as shown. Place the other details in their relative positions as given in the drawing, according to dimensions. For a better understanding of the details, consult isometric views of the window in Plate 77. Cover the woodwork with a light wash of burnt sienna, and the plaster with a pale tint of new blue.



DETAIL OF WINDOW FRAME

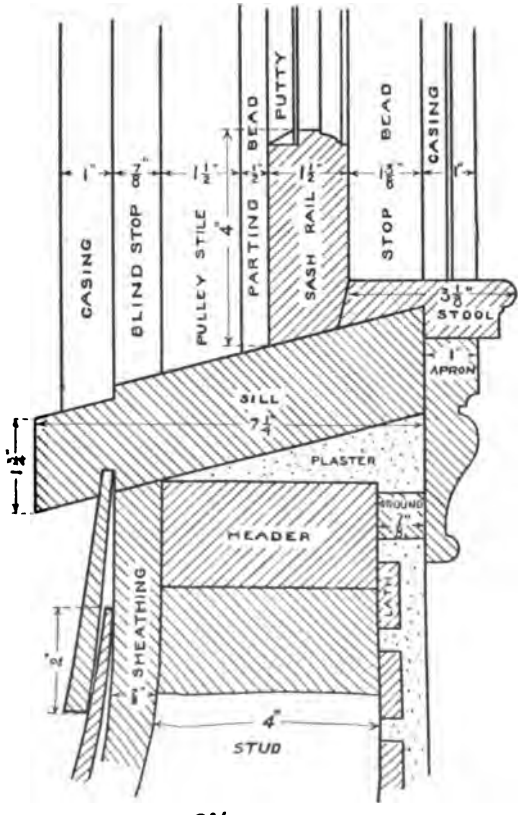


SECTION ON A-B

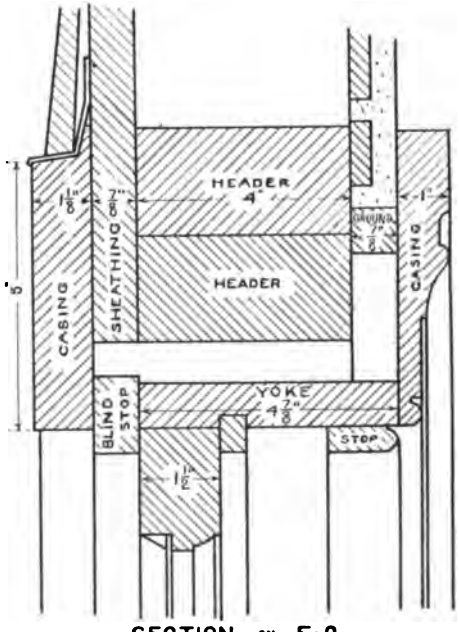
Copyright, 1899, by C. F. Edminster.

Plate 74.—The drawing at the left represents a vertical section passed through the window sill, and shows the studs, header, sill and various other details in their relative positions. The angle usually made by the sill and header is about 15°. The casing, blind stop, pulley style, parting bead and stop bead are seen beyond the section, their position being obtainable from the previous drawing. The drawing at the right gives the construction of the upper portion of the window, the positions of the principal details being taken directly from the drawing just described. The construction of the meeting rails is shown at the bottom of the sheet.

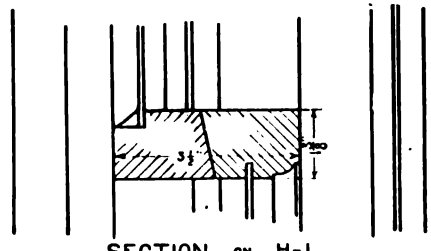
DETAILS OF WINDOW



SECTION ON C—D



SECTION ON F-G

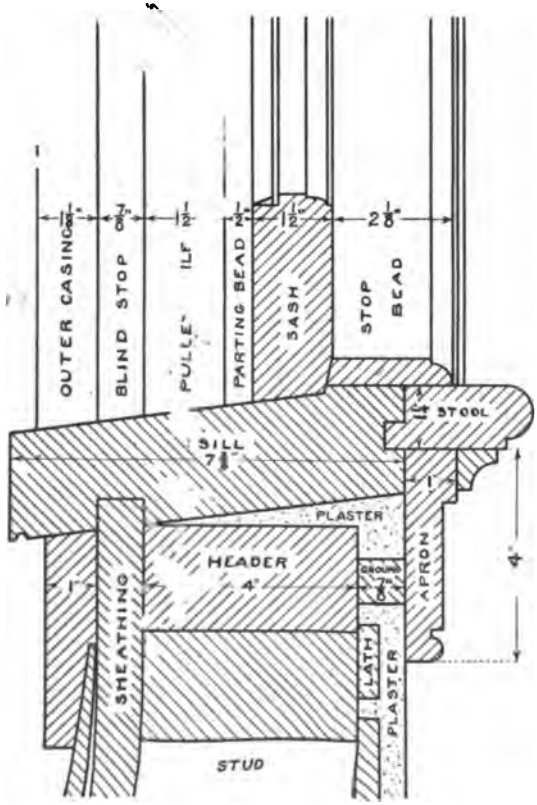


SECTION ON H-I

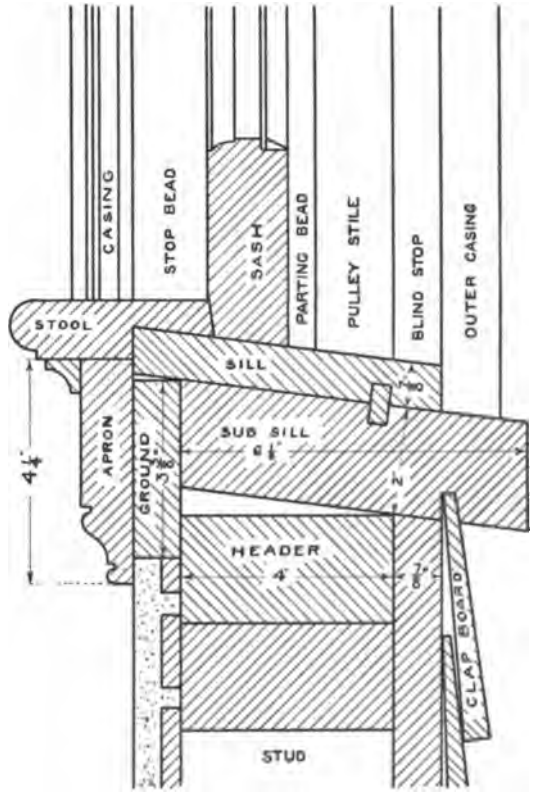
Plate 75.—This plate gives two more methods of constructing the window sill. In the drawing on the left the sheathing is allowed to extend into the sill, giving greater protection from the outer elements. The stool is ploughed into the sill, making a very strong, neat trim.

The drawing at the right shows the general method of putting together the wi w frame wher sill and sub-sill are used. They should be spli to-gether to form a greater protection against the wind and water, as the upper sill s very likely to draw away from the lower or sub-sill by the action of sun and rain. The other details essentially the s as given before.

DETAILS OF WINDOW



VERTICAL SECTION

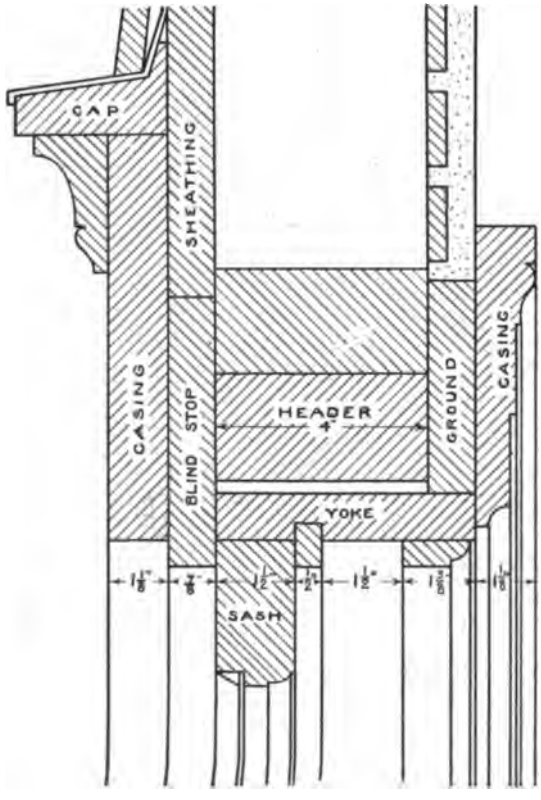


VERTICAL SECTION

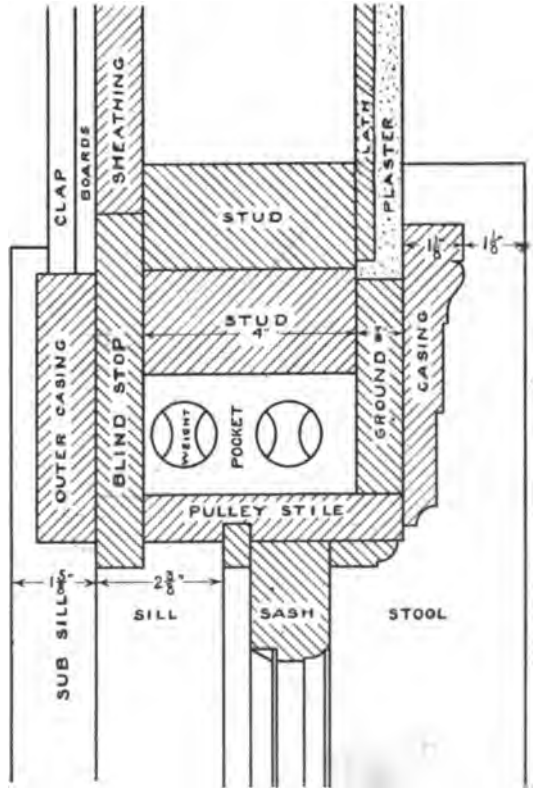
Plate 76.—The drawing on the left represents a vertical section through the upper portion of the window, and differs only in minor details from the one already given.

The drawing on the right is a horizontal section through the window. In this the blind stop runs back beyond the outside casing, thus permitting the clapboards to lap over and keep the outer atmosphere from entering the house. The ground is carried across the pocket and joins the pulley stile, again making it more difficult for air to penetrate. The other principles are essentially the same as in the previous plate.

DETAILS OF WINDOW FRAME



VERTICAL SECTION



HORIZONTAL SECTION

Plate 77.—This plate gives an isometric view of the lower and upper sections of the window frame. It is presented to give the students a clear conception of the manner in which the various parts of the window go together, and not as an exercise in drawing.

ISOMETRIC DRAWING WINDOW FRAME

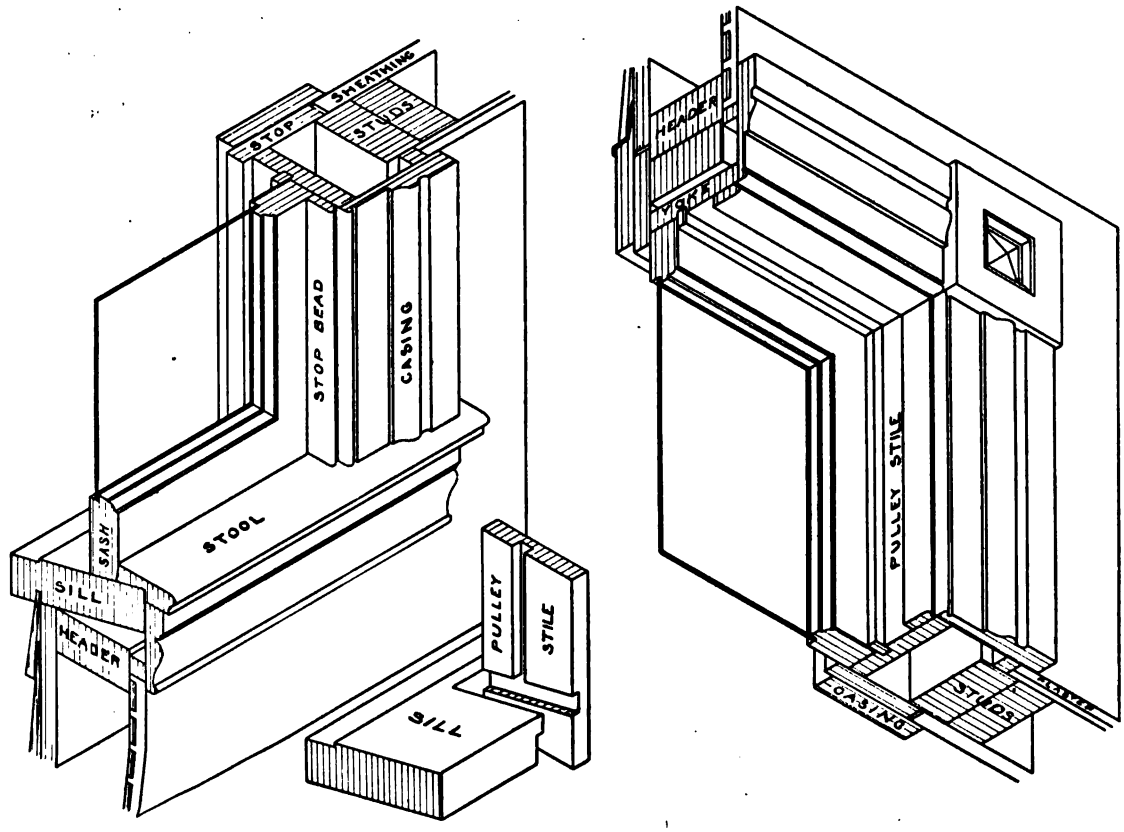
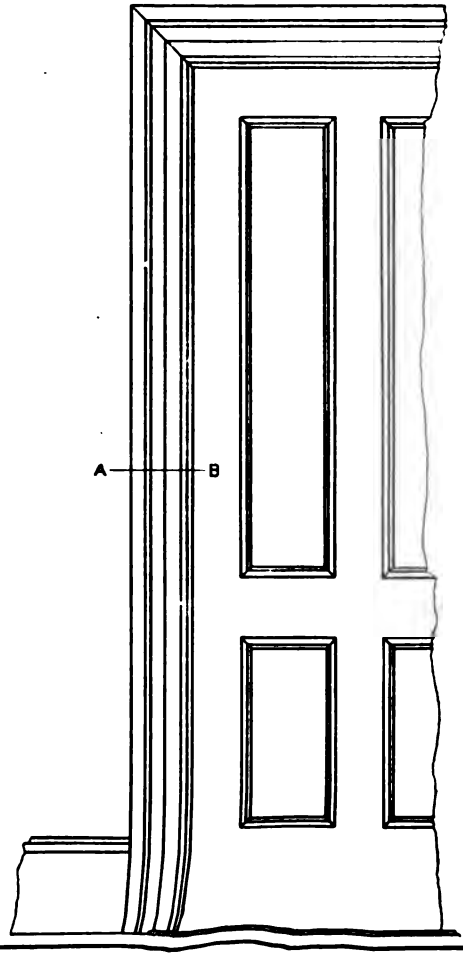
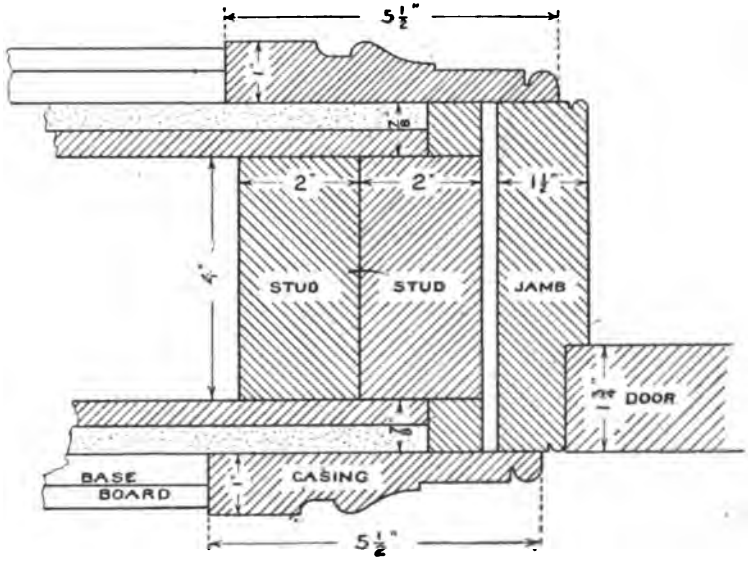


Plate 78.—The drawing at the left shows a portion of the elevation of a door and frame, that at the right is a horizontal section taken through A B. In making the section, it is well to begin with the double studs and then to place the ground, laths, plaster, and finally the jamb and casings. The jambs are rabbeted to receive the door, instead of using the nailed door stop which is very likely to become displaced. Draw the mouldings as given in the illustration, taking great care with the curved lines to keep them smooth and of the same strength as the straight lines.



DETAIL OF DOOR FRAME



SECTION ON A-B

Plate 79.—The drawing on the left portion of the sheet represents one of the best methods of supporting the floor joists of the second floor upon the partition below. The studs of the second floor should be allowed to extend through between the joists (as shown in the drawing), thus resting directly on the cap, and not upon a sole laid on the under flooring.

The drawing at the right shows the proper way of supporting a light partition that runs parallel to the floor beams below. The partition should be supported by at least two floor timbers, which are sufficiently spread to allow proper nailing of the upper flooring to the joist. The details of flooring, baseboard, lath and plaster, are similar to those in previous sheets.

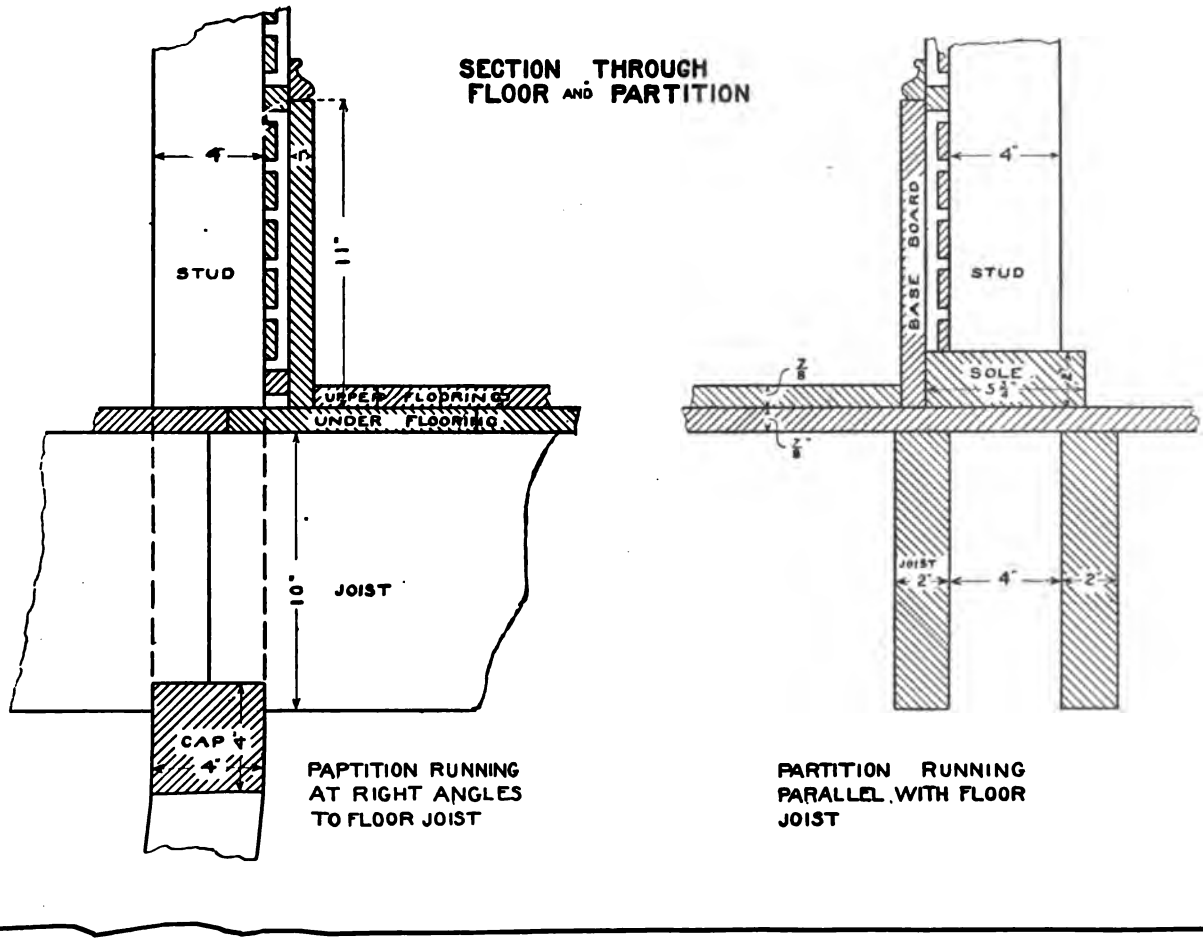
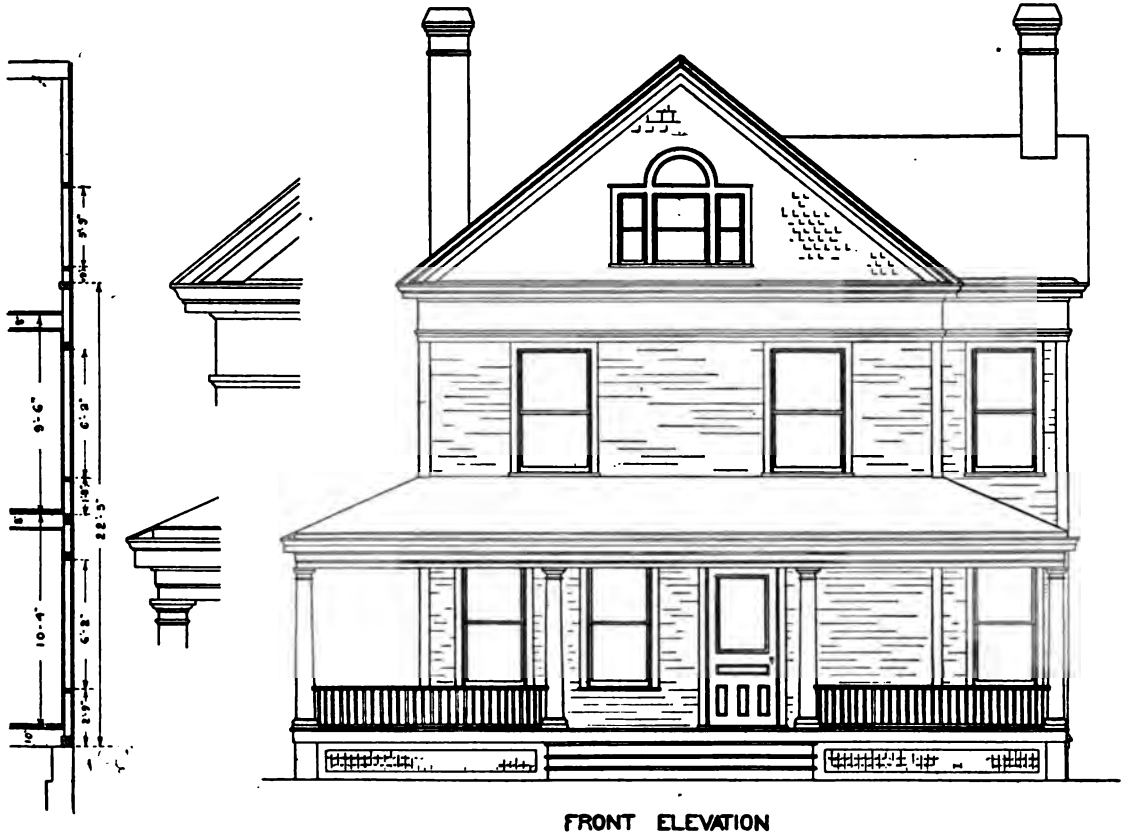

SECTION THROUGH
FLOOR AND PARTITION
4"
STUD
11"
UPPER FLOORING
UNDER FLOORING
10"
JOIST
CAP
4"
PAPTITION RUNNING
AT RIGHT ANGLES
TO FLOOR JOIST
BASE BOARD
4"
STUD
SOLE
JOIST
2"
4"
2"
PARTITION RUNNING
PARALLEL WITH FLOOR
JOIST

Plate 80.—Having completed the various detail drawings, the student has acquired sufficient knowledge to enable him to make an intelligent drawing of an elevation. That is, he should now comprehend that all the various lines of the windows, doors, cornices and other parts, have a real meaning.

Before beginning the elevation, it is always wise to draw a vertical section. In this section are indicated the levels of the foundation, sill, floor timbers, windows, girts and plate. The main outlines of the building, and the position of the windows, doors, columns and chimney can be taken directly from the plans. The vertical heights of the various details are projected directly across from the section. The two details at the left of the elevation are not to be drawn by the student, but are placed there simply as an aid, being nearly the size of the required drawing, if drawn to a scale of $\frac{1}{4}$ in. equals 1 ft., which scale is very common for houses of this type.

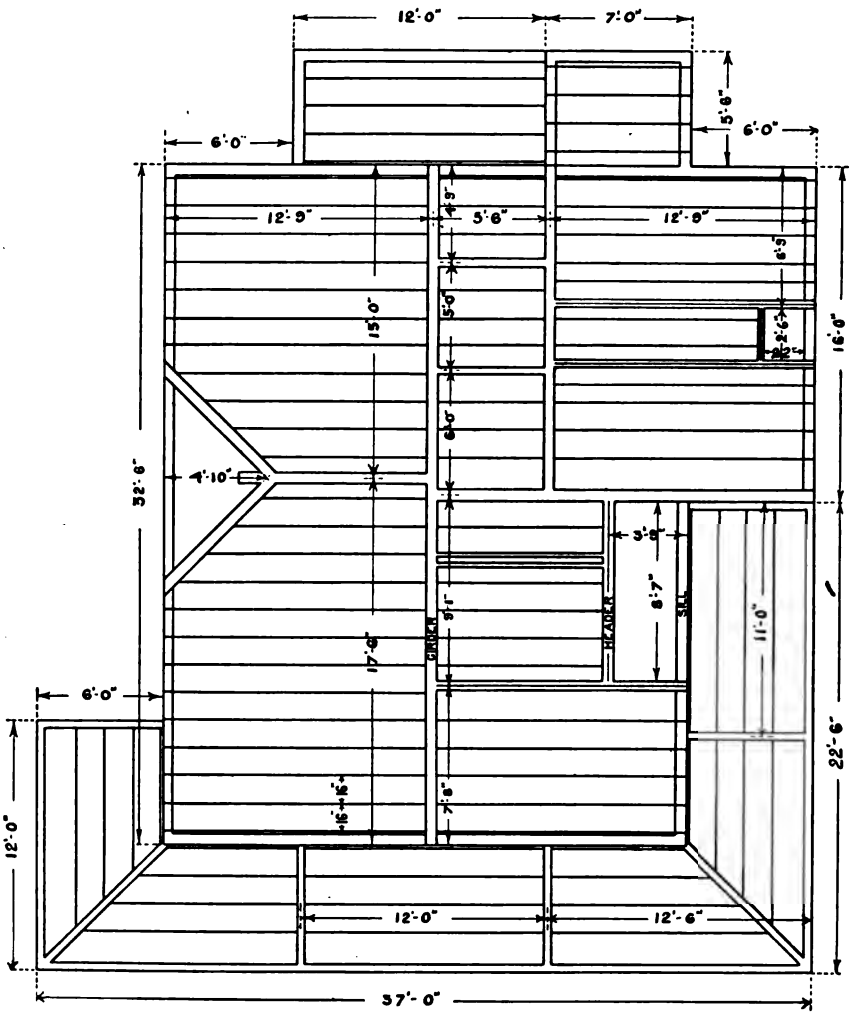


FRONT ELEVATION

Plate 81.—This drawing is to be carried out in a manner similar to the last, the principal horizontal measurements being taken from the plans, and the vertical measurements from a section, or from the front view already drawn. It would now be well for the student to draw another view without the aid of an illustration.

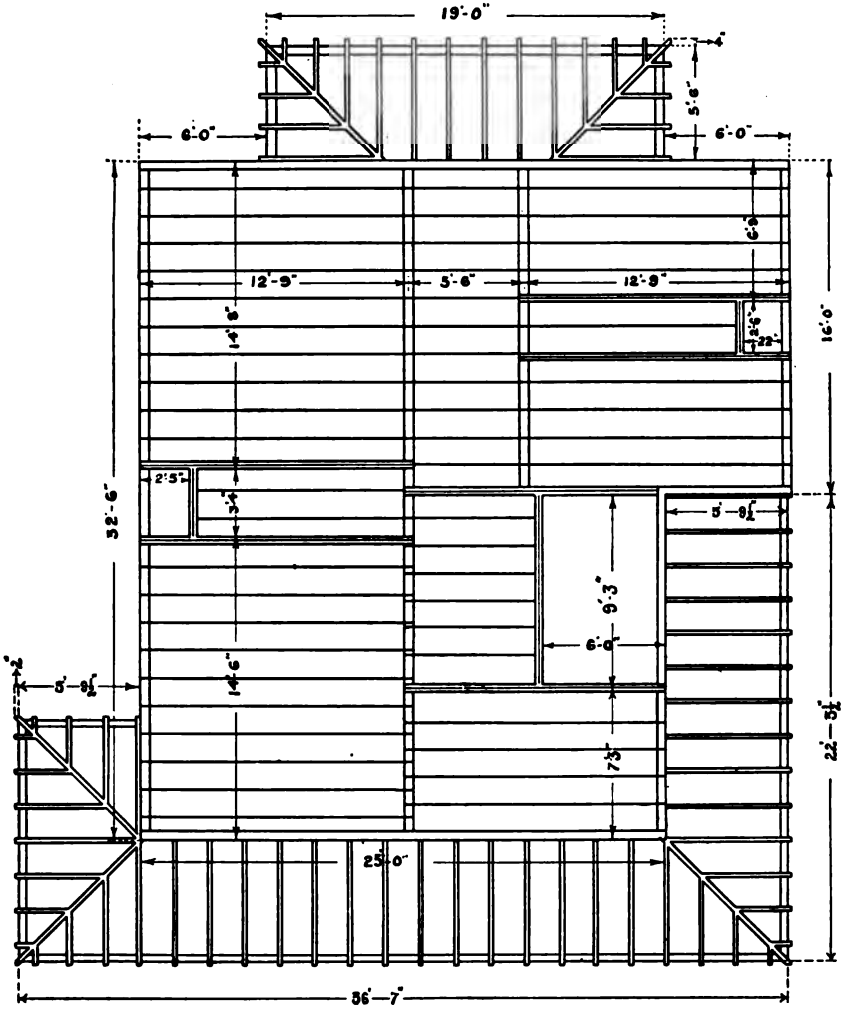
SIDE ELEVATION

Plate 82.—In a frame house the outlines of the sills generally coincide with the outlines of the plan. Having drawn the sills in their proper positions, we next locate the girders which are usually placed under the main partitions, as in this drawing. Trimmers and headers should then be located about the stair wells and chimneys. Where partitions do not rest upon a girder, the floor should be reinforced by an extra joist. Last of all, place the center lines of the floor timbers, which are usually from 16″ to 20″ apart. The floor timbers in the piazza run parallel to the building, and their tops are in a plane which inclines slightly downward from the house.



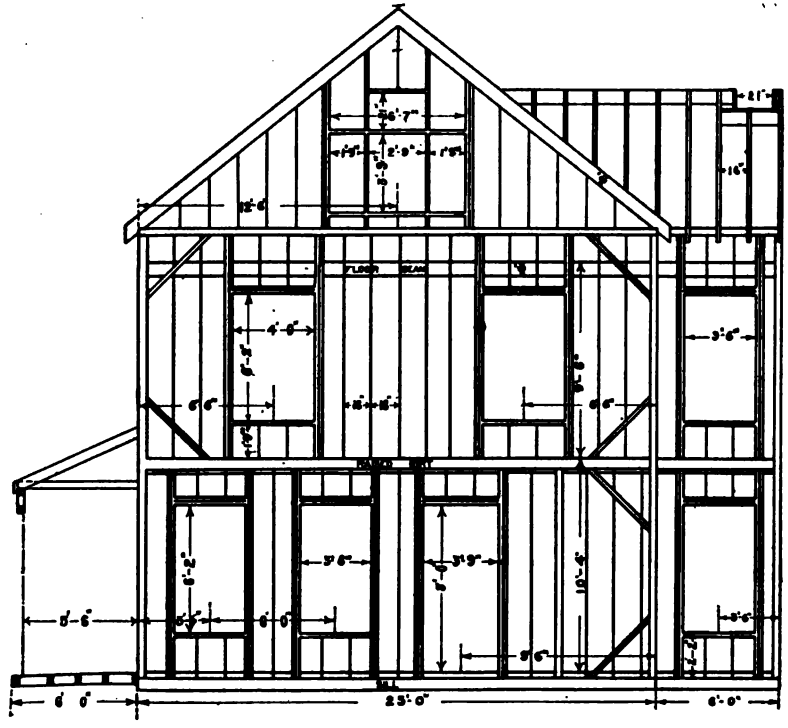
FRAMING FIRST FLOOR

Plate 83.—This drawing is carried out in the same general order as given in the first floor framing plan, the raised and drop girt taking the place of the sill, and the partition cap the place of the girder. Locate the proper trimmers and headers, after which place the remaining floor timbers. The student will also notice that in the piazza the plate has taken the place of the sill, and the rafters the place of floor timbers. The rafters, however, are at right angles to the floor beams.



FRAMING SECOND FLOOR

Plate 84.—In this drawing the student should first locate the sill, then the corner posts, raised girt, attic floor beams, plate and rafters. The lengths of the sills are taken from the plans, and the vertical height of the posts from the vertical section on Plate 80. All windows and openings are located from the plan, their height being in the section on Plate 80. It will be noticed that the openings for the windows are considerably wider than in the plan. The difference is made to allow for the space occupied by the pulley stiles and pockets, which in small cottages is about 6″. When we speak of a window 3′-0″ wide, we mean that the sash is 3′-0″, in other words, the space from pulley stile to pulley stile. The studs are usually placed 12″ or 16″ from center to center, and are indicated by a single center line. The piazza is not given on the front side of the building, as it would complicate the drawing, but a section is shown on one side.

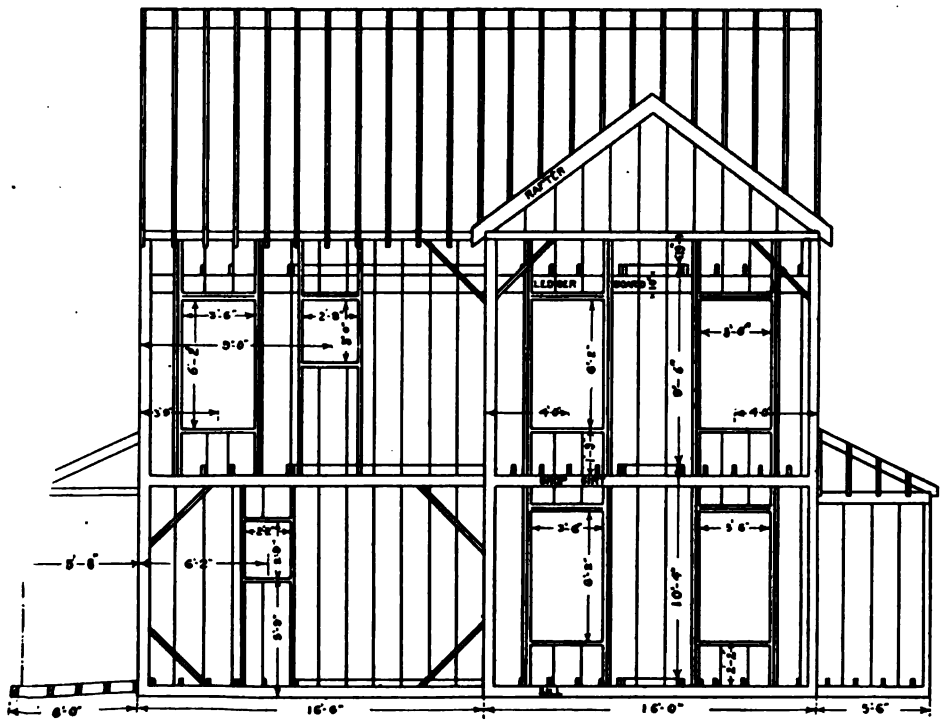


FRAMING FRONT ELEVATION

Plate 85.—This plate requires little explanation, as the method pursued is not unlike the foregoing sheet. The student may note that the ends of the floor timbers and the 6″ faces of the corner posts are shown.

This view also presents the dr
the floor beams of the second
board which supports those of

pied by the pulley
cottages is about
'-o″ wide, we mean
s, the space from
studs are usually
ter, and are indi-
azza is not given
it would compli-
rn on one



FRAMING SIDE ELEVATION

Plate 86.—This isometric view of the framing of the corner of a house is not given as an exercise in drawing, but to help the student who is not familiar with the subject to locate the different parts.

ISOMETRIC DRAWING
FRAMING OF CORNER

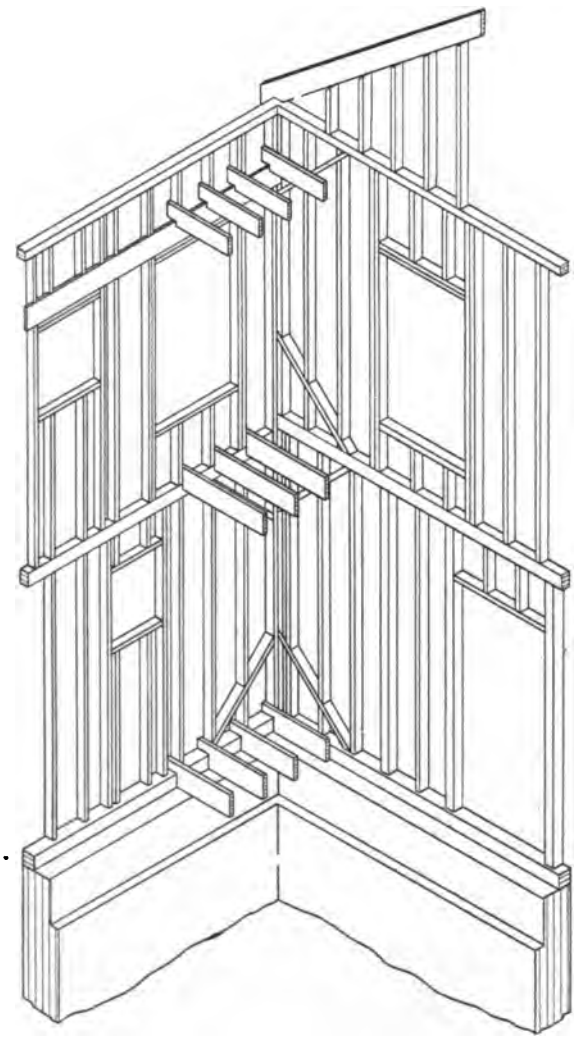
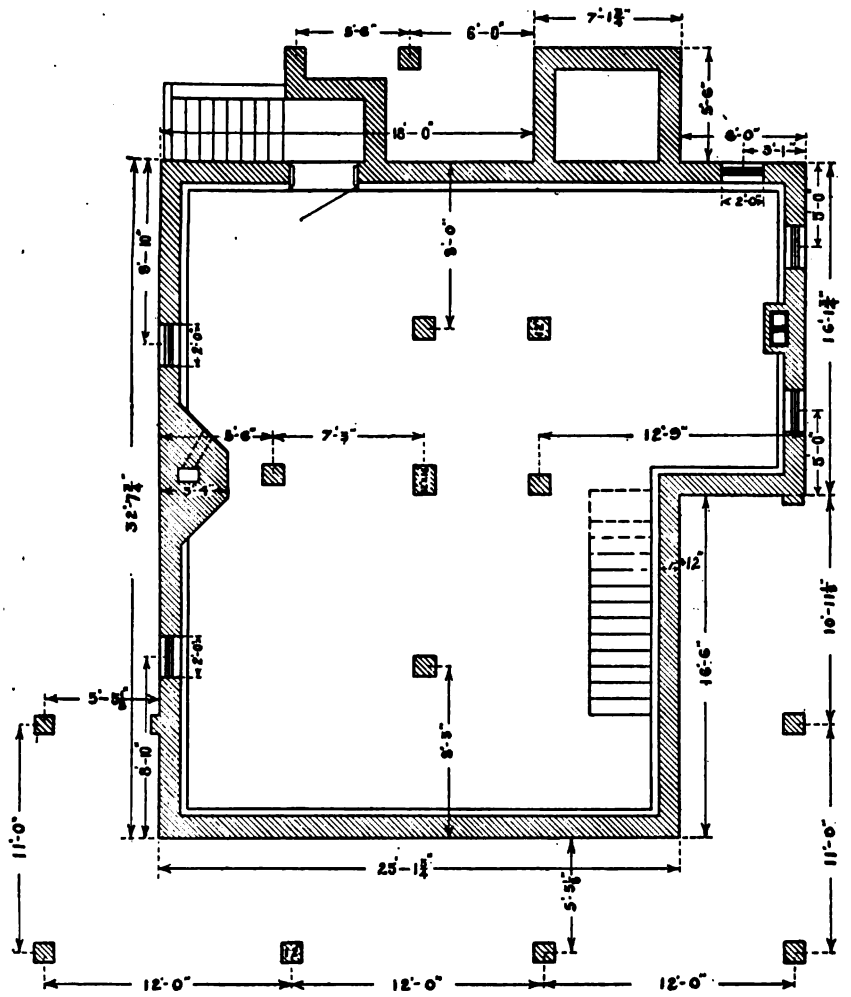


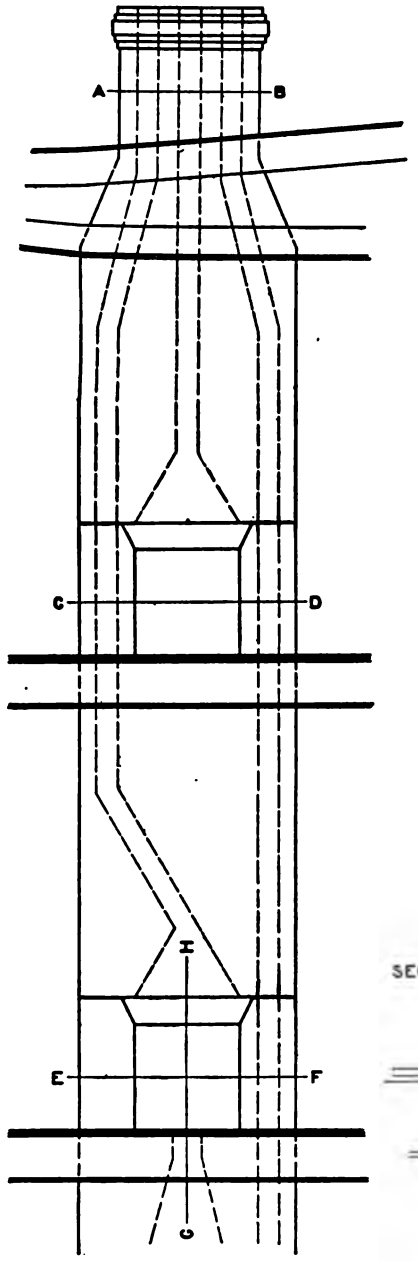
Plate 87.—The foundation is built up to the grade level, or height at which the ground will be left, with 16″ undressed stone masonry; and from that level to the sill line, with dressed stones 12″ thick. As will be seen by the detail drawing of the water table in Plate 68, the outside line of this stone wall and the rough boarding are in the same plane, consequently we must add the two thicknesses of sheathing boards, 1¼″, to the measurements given in the plan. For instance, if the front of the house measures 25′-0″, the foundation should be 25′-1¼″. The piers in the cellar are located under the principal girders, and those under the piazza should be directly in line with the columns. Tint the cellar walls gray or brown, according to the stone in use. If the piers are of brick, tint them red.

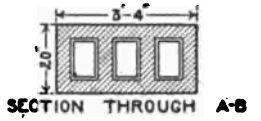

5'-6"
6'-0"
7'-1½"
16'-0"
5'-6"
6'-0"
5'-1"
2'-0"
5'-0"
9'-0"
8'-10"
2'-0"
16'-1½"
5'-6"
7'-3"
12'-9"
5'-0"
32'-7½"
5'-3"
12"
16'-6"
10'-11½"
2'-0"
5'-5½"
6'-0"
8'-3"
11'-0"
25'-1½"
5'-5½"
11'-0"
12'-0"
12'-0"
12'-0"

CELLAR PLAN

Plate 88.—The drawing at the left represents the elevation of a chimney, showing fire-places on the first and second floors, and the position of the flues from the two fire-places and the furnace. Sections A-B, C-D and E-F show the manner of representing such in a plan. Section G-H gives the general construction of the fire-place, showing the flue to the ash pit, the trimmer arch, the fire-brick lining in the fire-place, the manner of narrowing the throat, and the position of the terra cotta linings in the main flue. The chimney should always be constructed with an 8″ wall around the flue or be lined with terra cotta linings, as shown in this drawing; these linings are about $\frac{1}{8}$″ in thickness, and come in sections 2′-0″ long. They are built into the flue during the construction of the chimney.

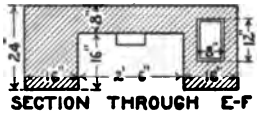
CHIMNEY CONSTRUCTION.



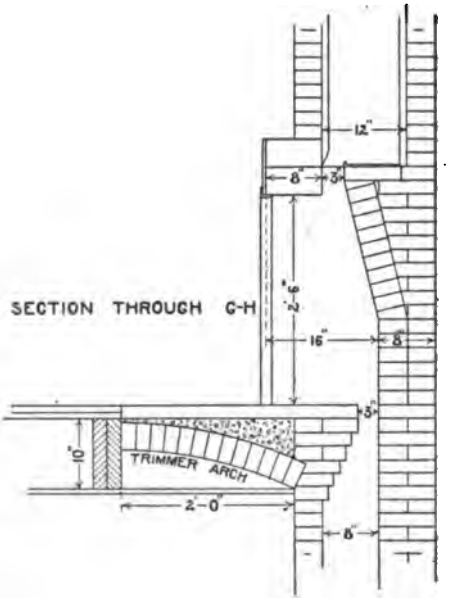


SECTION THROUGH A-B

SECTION THROUGH C-D

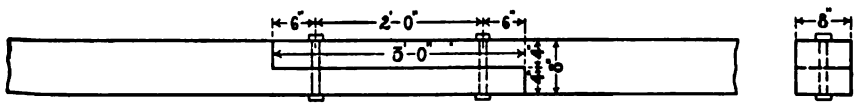


SECTION THROUGH E-F

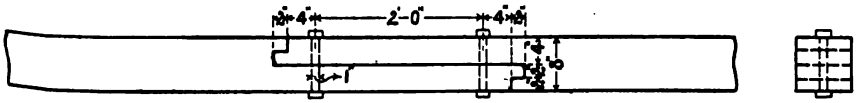


SECTION THROUGH G-H

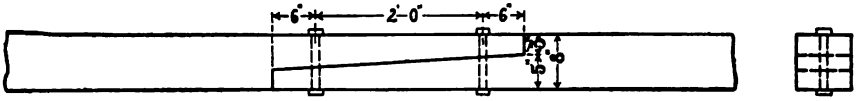
Plate 89.—Several of the general methods of splicing timbers are illustrated in this plate. The measurements are given merely to assist the student in drawing, as they differ materially in practice, according to conditions and the kind of lumber used.



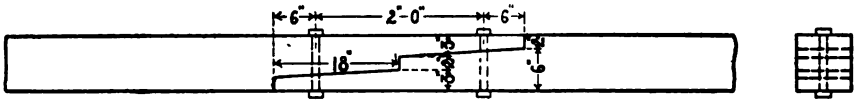
LAPPED JOINT



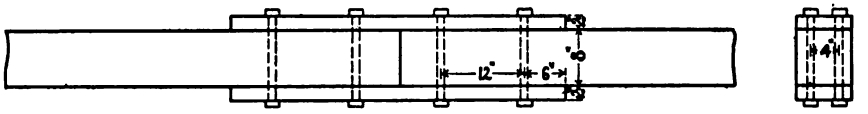
SPLICED JOINT



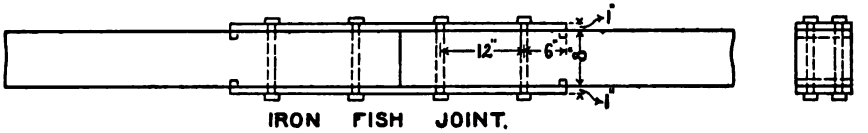
SCARFED JOINT



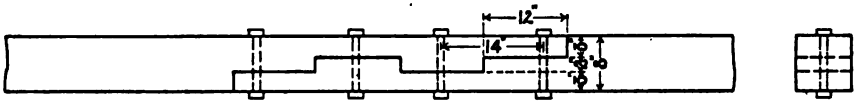
LOCK-SCARFED JOINT



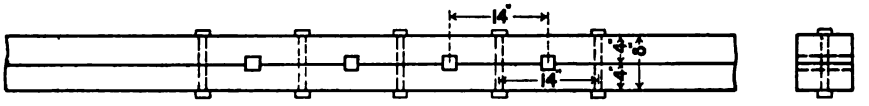
FISHED JOINT



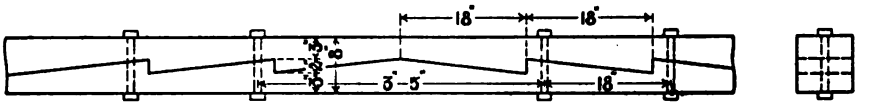
IRON FISH JOINT.



JOGGLED JOINT



BUILT BEAM KEYED



BUILT BEAM SCARF-LOCKED

Plate 90.—Fig. 1 shows the front and top views of a sill, corner post and stud, and the manner of framing the parts together. Figs. 2, 3 and 4 show different methods of framing sills together. Fig. 5 shows the method of supporting a floor timber upon a girder by means of an iron stirrup. Fig. 6 gives a very simple method of supporting a floor timber upon the girder. This is done by bolting a 2″ x 4″ joist upon the lower edge of the girder and allowing the floor timber to be notched out to rest upon this. Where this method is employed iron dogs should be used frequently to prevent the floor timbers from pulling away from the girder. Fig. 7 shows the method of constructing the regular tusk and tenon joint. The objection to this joint is that it is frequently made in a careless manner, bringing the full weight upon a small portion of the tusk, which is liable to give way and cause serious settlement. If made properly, however, it is a very good form of joint to use.

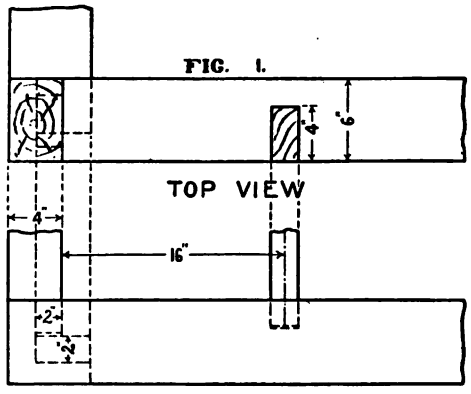


FIG. 1.
4"
6"
TOP VIEW
4"
16"
2"
2"
FRONT VIEW

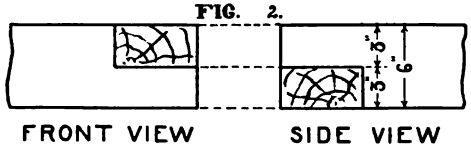


FIG. 2.
3"
3"
6"
FRONT VIEW
SIDE VIEW

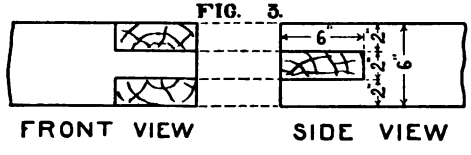


FIG. 3.
6"
2"
2"
2"
6"
FRONT VIEW
SIDE VIEW

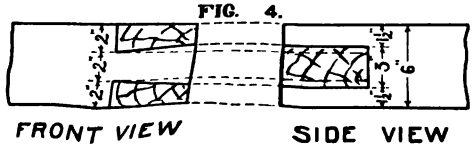


FIG. 4.
2"
2"
2"
3"
6"
FRONT VIEW
SIDE VIEW

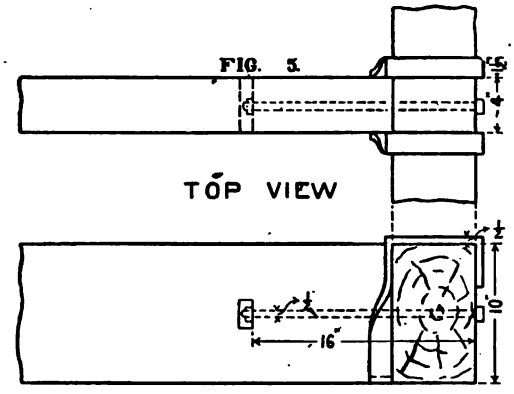


FIG. 5.
TOP VIEW
16"
10"
FRONT VIEW

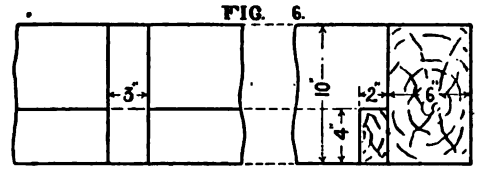


FIG. 6.
3"
10"
4"
2"
6"
FRONT VIEW
SIDE VIEW

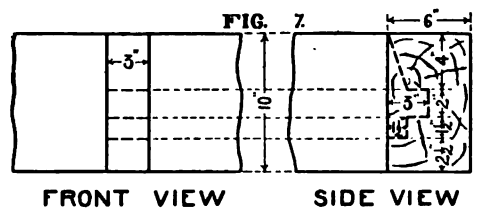


FIG. 7.
6"
3"
10"
4"
3"
FRONT VIEW
SIDE VIEW

CHAPTER IX.

STUDIES IN MASONRY CONSTRUCTION.

Plate 91.—In this plate are given several forms of arches in general use, and the names which are applied to the various parts.

Fig. 1 shows a relieving arch placed over a lintel in such a way as to take the weight from the lintel below. This form of arch should be used whenever there is danger of a lintel becoming injured by a heavy strain, or where wood is used, which may decay or be destroyed by fire. Fig. 2, on which the names of the various parts are indicated, represents two segmental arches. The segmental arch has for its intrados a segment of a circle. Fig. 3 gives the drawing of a flat arch, or one that has a straight line for its intrados. In practical construction, this line should curve up slightly, as the arch is likely to sag as the building settles. Fig. 4 represents a semicircular arch, or one that has for its intrados a semicircle; Fig. 5, a pointed arch, or one that has for its intrados arcs of circles, the chords of which usually form two sides of an equilateral triangle.

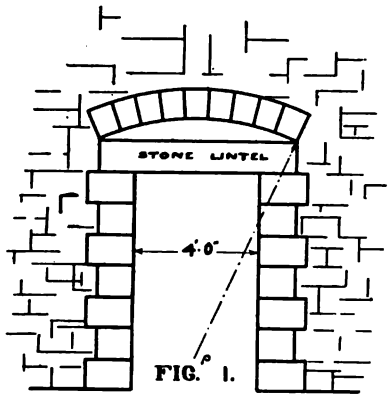


FIG. 1.

RELIEVING ARCH.

a. PIER.
b. ABUTMENT.
c. SPAN.
d. RISE.
e. HAUNCH.
f. INTRADOS.
g. EXTRADOS
h. KEYSTONE.
i. VOUSSOIRS.
k. SPRINGING.
m. SPANDREL.
o. SKEWBACK.
P. CENTER.

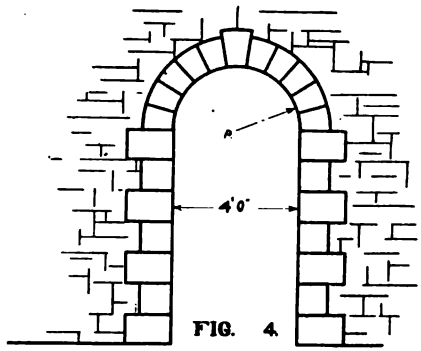


FIG. 4.

SEMICIRCULAR.

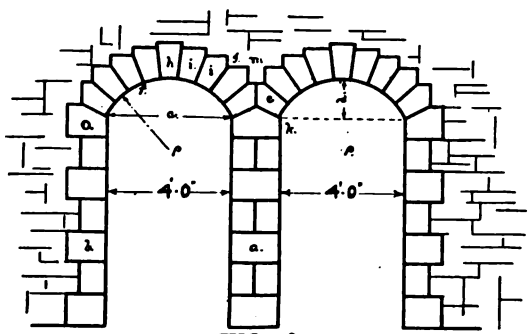


FIG. 2.

SEGMENTAL ARCH.

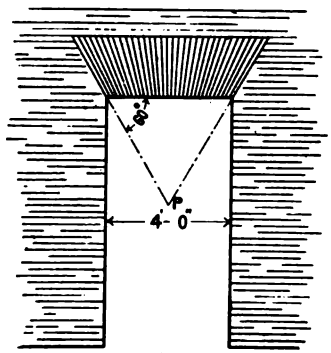


FIG. 3.

FLAT ARCH.

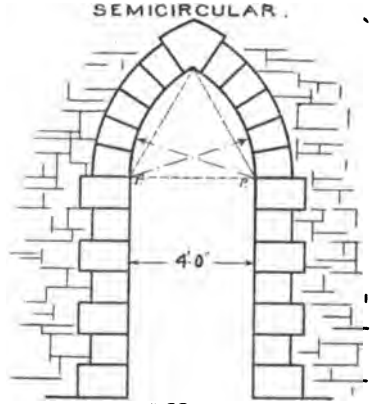
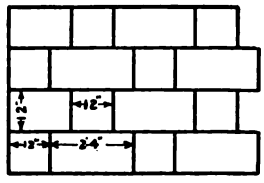


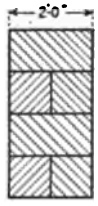
FIG. 5.

POINTED ARCH

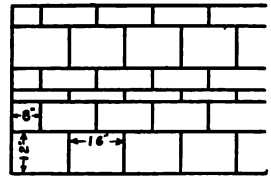
Plate 92.—This sheet is planned particularly to show the principal methods of constructing a stone wall. The illustrations are so simple that explanations are hardly necessary.



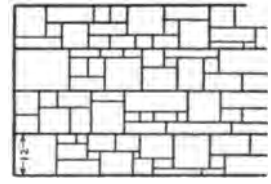
REGULAR COURSED MASONRY



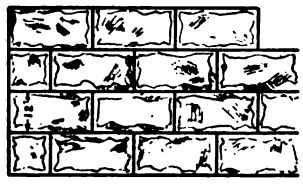
SECTION



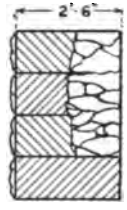
IRREGULAR COURSED



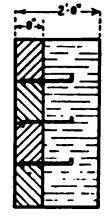
RANDOM WORK in LEVEL COURSES



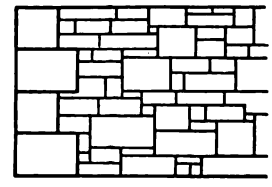
ROCK FACED REGULAR COURSED



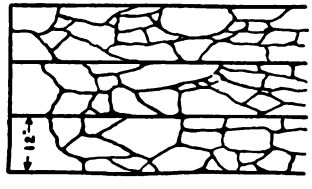
SECTION



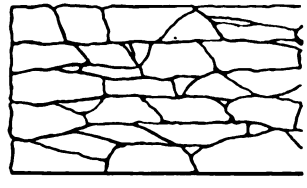
THIN ASHLAR FACING



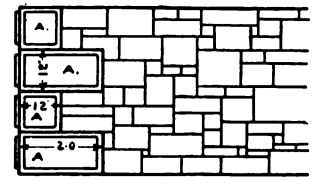
RANDOM ASHLAR



RUBBLE IN LEVEL COURSES



RANDOM RUBBLE



A. QUOIN STONES.

Plate 93.—We have the first and second floor plans of a city house of moderate cost. This house is supposed to be one of several in a block, therefore the two side walls become party walls. The width of the house is given to the centers of the party walls. The conventional method of representing the various parts in this plan differs little from that of the cottage, the principal difference being in the manner of representing the windows. The laundry is located in the cellar, of which there is no drawing in this series. The walls, which are section lined, may be tinted, using light red for the brickwork, and a light wash of burnt sienna for the wooden partitions.

Plate 93.

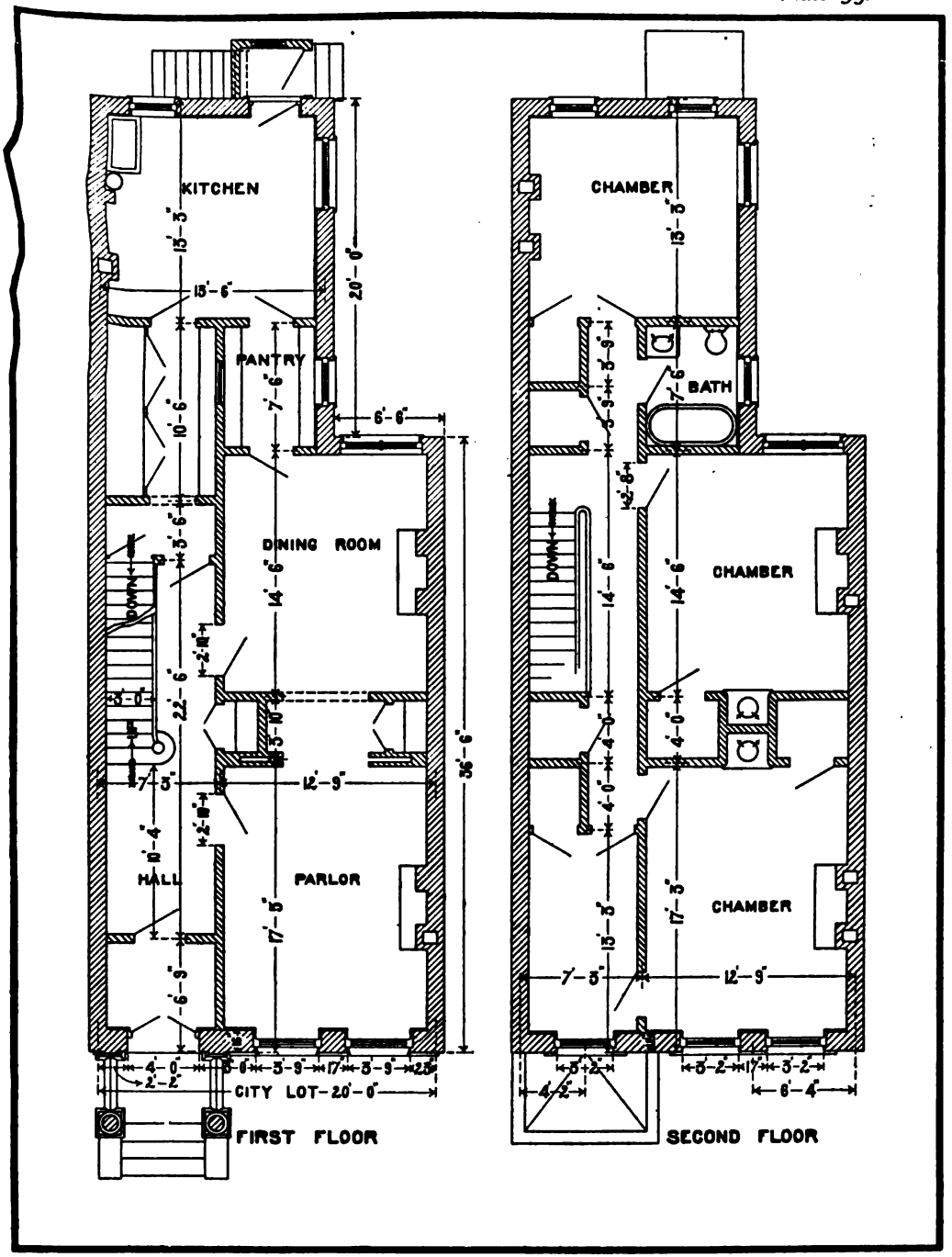
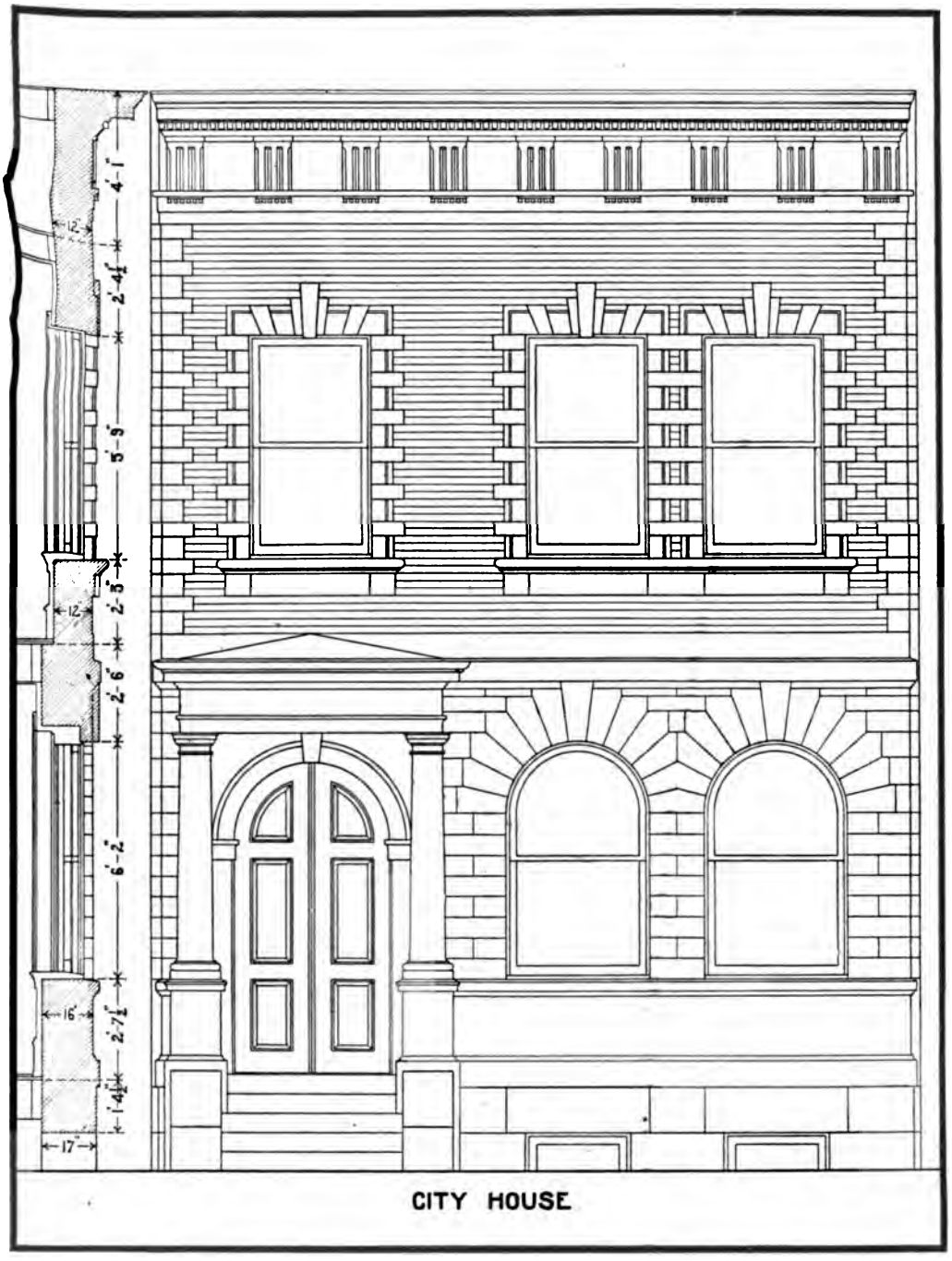

KITCHEN
PANTRY
DINING ROOM
HALL
PARLOR
DOWN
CITY LOT-20'-0"
FIRST FLOOR
CHAMBER
BATH
CHAMBER
CHAMBER
DOWN
SECOND FLOOR

Plate 94.—The vertical section on the left should be drawn first, according to dimensions given. The positions of the windows and door may be obtained from the plan. Usually it will be found desirable to draw this to a larger scale than that used in this drawing.

Plate 94.



CITY HOUSE

Plate 95.—This drawing gives the horizontal and vertical sections through a window frame as constructed in a brick or stone house. The principal features are practically the same as explained in the frame house. To obtain satisfactory results, the drawing should be made nearly full size, placing many measurements which are omitted in this. This drawing will be found to correspond to one of the lower windows in Plate 94.

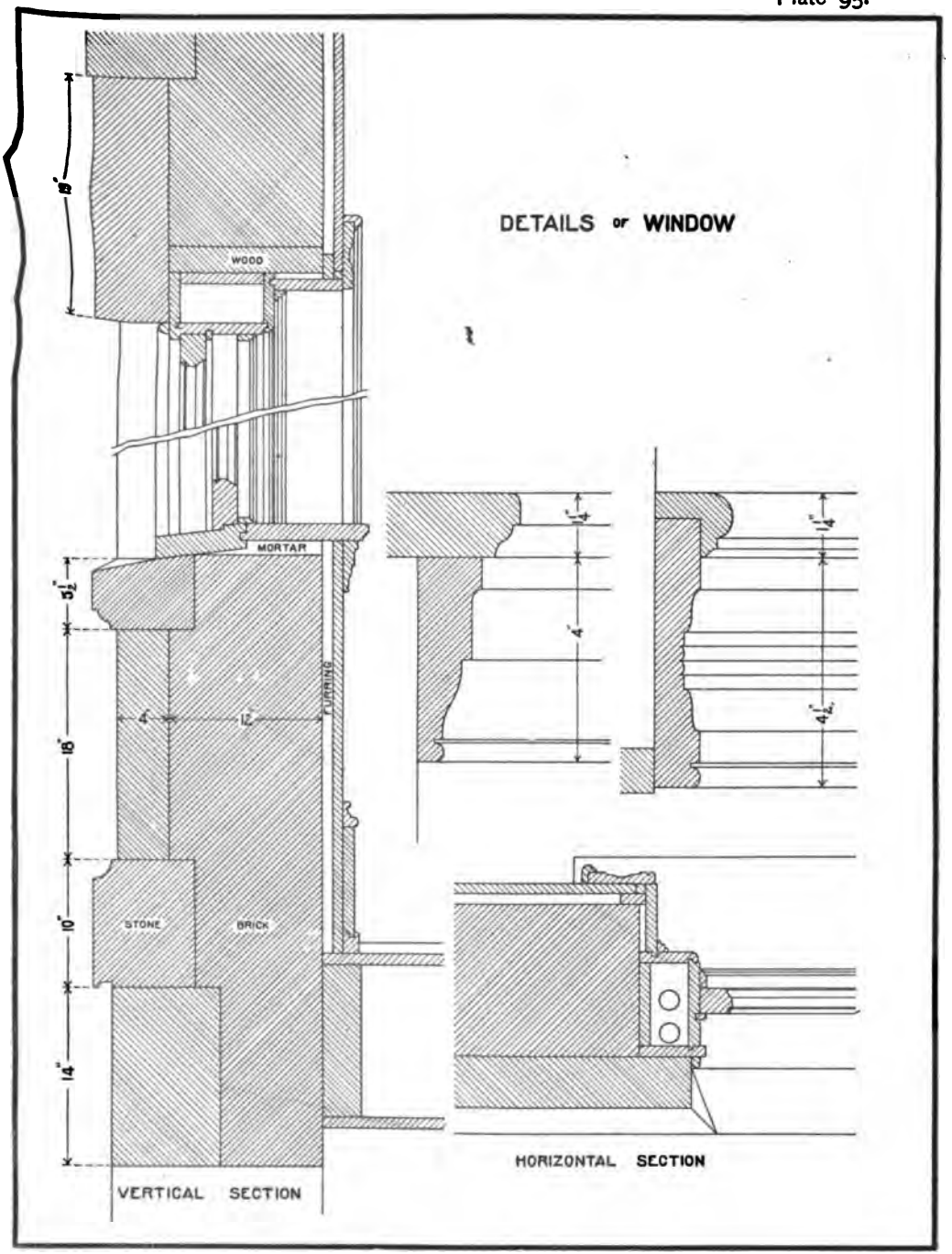
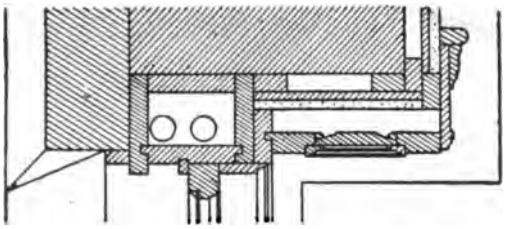

DETAILS OF WINDOW
WOOD
MORTAR
FURRING
STONE
BRICK
4"
12"
5½"
18"
10"
14"
1¼"
4"
4½"
VERTICAL SECTION
HORIZONTAL SECTION

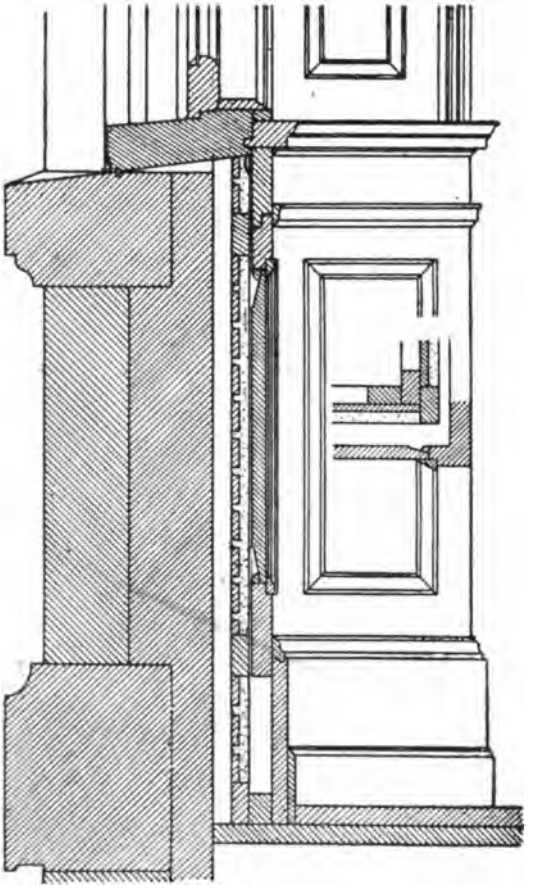
Plate 95A.—This drawing gives the horizontal and vertical sections of a window of different construction from the preceding plate. The details of paneled wainscoting should be carefully studied.

A good exercise in design will be to draw the sections full size, the paneling and mouldings to be varied by the student.



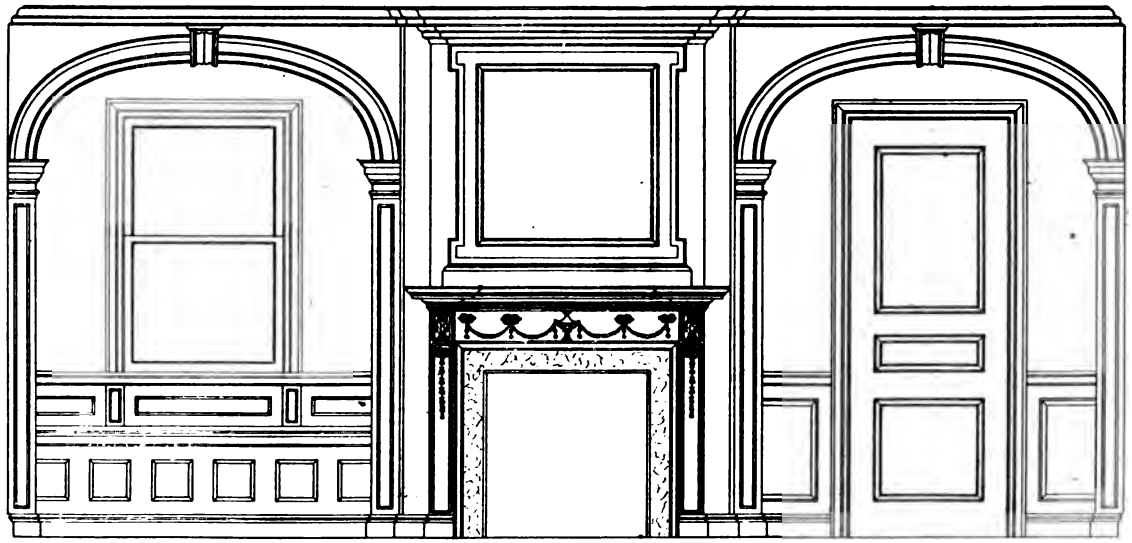
HORIZONTAL SECTION

DETAILS
OF
WINDOW



VERTICAL SECTION

Plate 96.—This offers a suggestion for an interior in the Colonial style, which should be drawn to a much larger scale. In addition to this it would be well for the student to make several full-sized detail sections.



AN INTERIOR STUDY

CHAPTER X.

STAIR CONSTRUCTION.

Plate 97.—This plate presents several plans of stairs given as suggestions or general help in planning. Fig. 1 gives a quarter-turn winding staircase. The great objection to this form of staircase is the narrowness of the tread along the line of travel; therefore it is not to be recommended and should be used only where it is an absolute necessity. Fig. 2 represents a double platform staircase with angle-posts at each platform. Fig. 3 shows a quarter-turn platform staircase with a continuous hand-rail. Fig. 4 is the plan of a winding staircase, showing how the objectionable narrowness of winding treads is overcome to a certain extent, by ending the treads in the form of a cylinder, and not radiating the risers from a common center. Fig. 5 is the plan of a circular staircase. In this also the treads do not radiate from a common center. The line of travel is 14 inches from the hand-rail, on which the width of tread is laid out.

FIG. 1

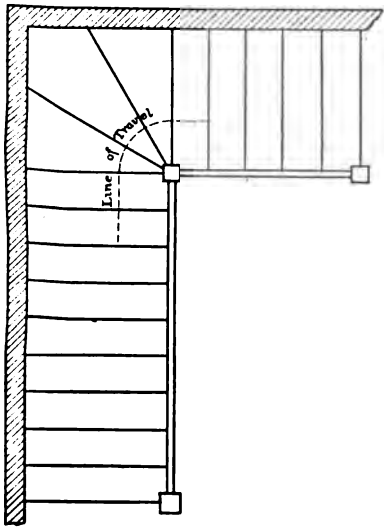


FIG. 2

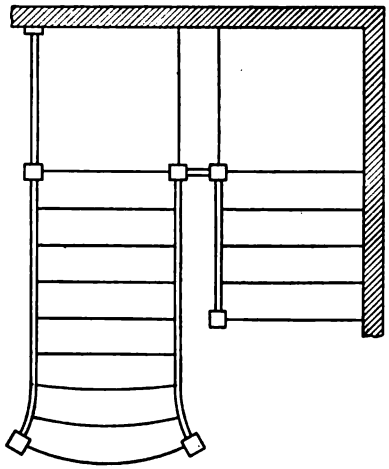


FIG. 3

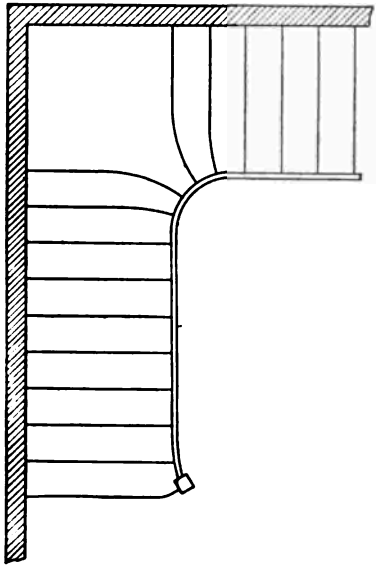


FIG. 4

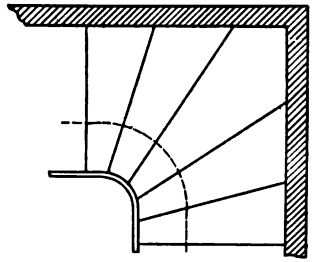


FIG. 5

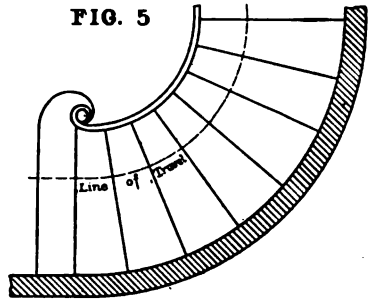


Plate 98.—This plate gives the front and top views of an open-string staircase.

In laying out a flight of stairs, the first thing to be considered is the distance in inches from floor to floor. This measurement is then divided into a certain number of vertical distances, each of which is termed the rise, and is usually about 7 inches in height. The rule that is frequently applied in proportioning the rise to the run is, that the rise in inches multiplied by the run in inches shall be about 70 or 75. According to this, a riser that is 7 inches will require a tread that is about 10½ inches. The draughtsman will see by this rule that the greater the rise the less the run, or the less the rise the greater the run; these proportions vary with the limited position the staircase may have to occupy. In public buildings the rise is frequently as low as 5 or 5½ inches and the run proportionally wide.

The enlarged drawings of the newel and balusters are given to show more clearly the profile of the mouldings, and thus assist the student in making the drawings.

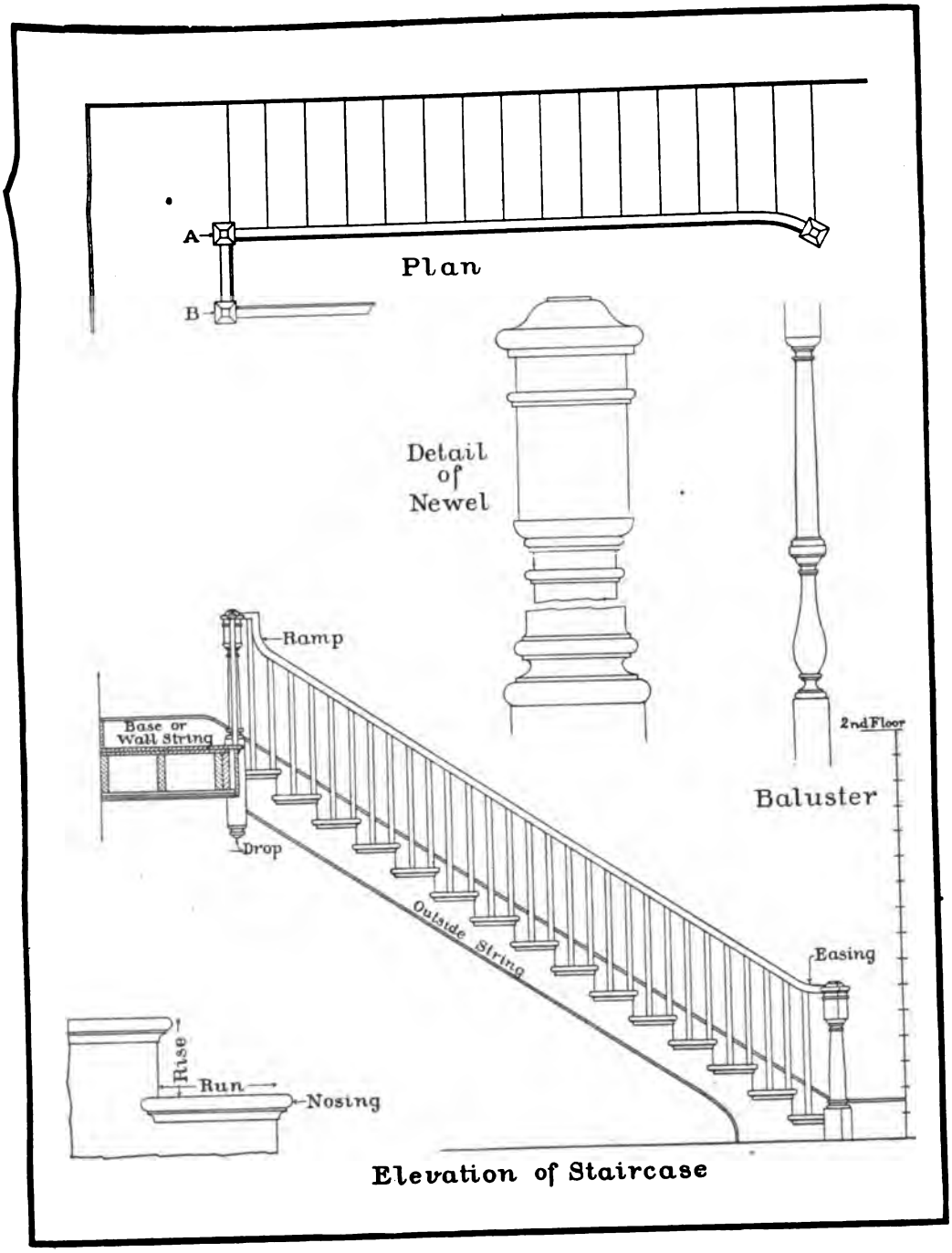
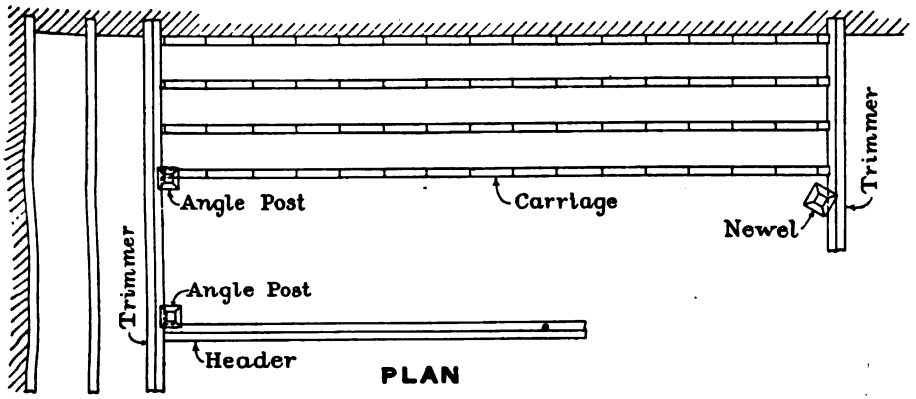
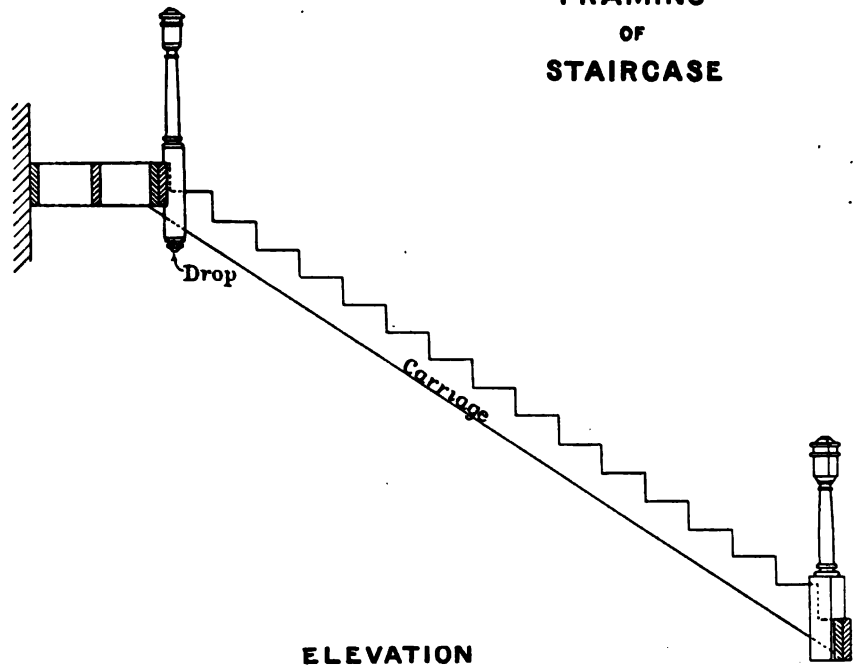

A
B
Plan
Detail of Newel
Baluster
Ramp
Base or Wall String
Drop
Outside String
2nd Floor
Easing
Rise
Run
Nosing
Elevation of Staircase

Plate 99.—This drawing shows the general position and arrangement of the framework of the staircase on Plate 98, locating the newels and angle-posts in their respective places. Care must be taken to locate these so as to receive the hand-rail on its center line. This location can be obtained by referring to Plate 103 at A. The narrowest part of the carriage should be at least 5 or 6 inches wide.



PLAN

FRAMING OF STAIRCASE



ELEVATION

Plate 100.—Fig. 1 gives the isometric projection of the framework of the upper portion of the staircase, while in Fig. 2 the lower portion is represented. With these two drawings the student will readily see the relative positions of the various timbers, and also the manner in which the newel and angle-posts are cut.

FIG. 1.

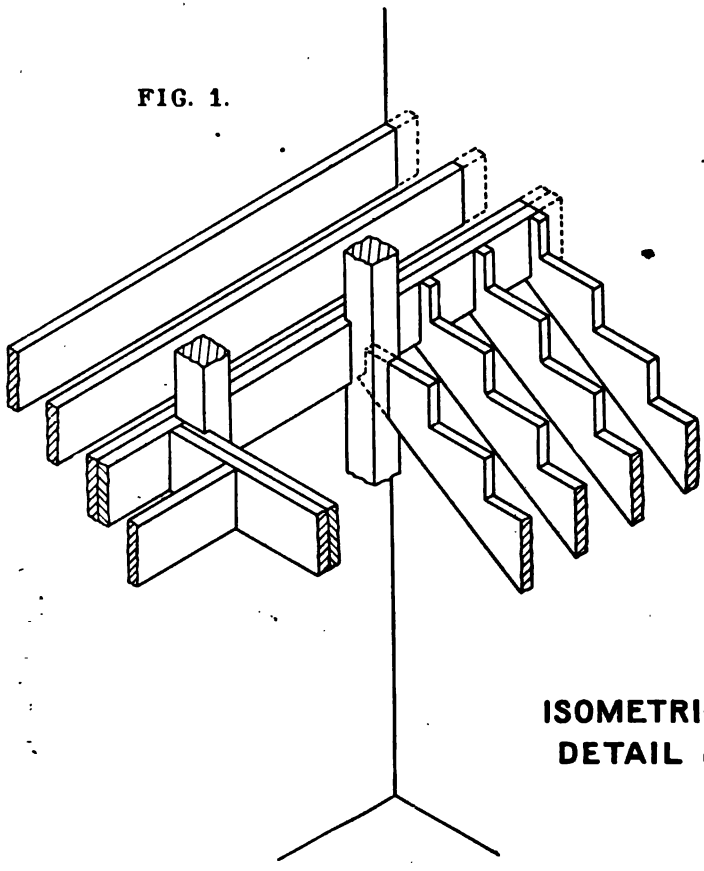
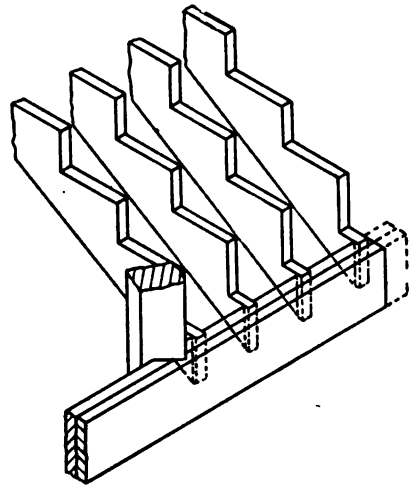


FIG. 2



ISOMETRIC DRAWINGS
DETAIL OF FRAMING

Plate 101.—Fig. 1 represents a portion of the staircase in which the risers and treads are supported by the carriages cut to the shape of the stair. In this form the risers and treads are usually ploughed to receive the wall-string. In Fig. 2 we have an isometric projection of a portion of a flight of stairs, in which the risers and treads are housed to the inner and outer strings. The center carriages are constructed as shown in this illustration by nailing pieces of board, cut to the desired shape, to carriage timbers, which measure 2" x 6" or 3" x 6", as the position may demand.

FIG. 1

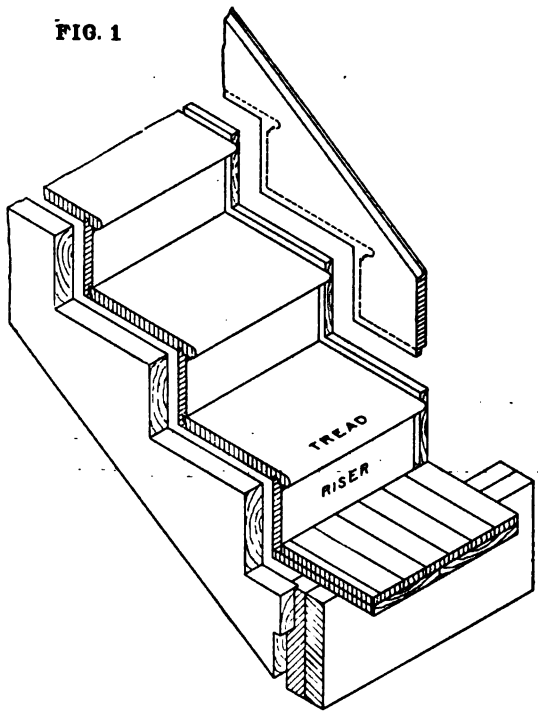
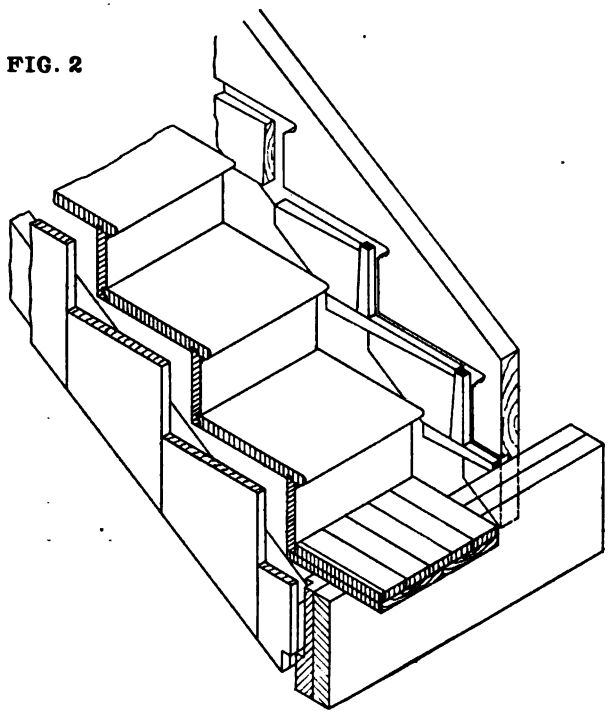


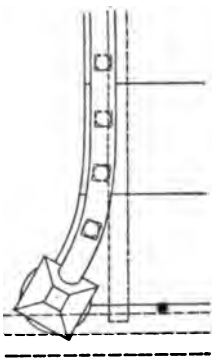
FIG. 2



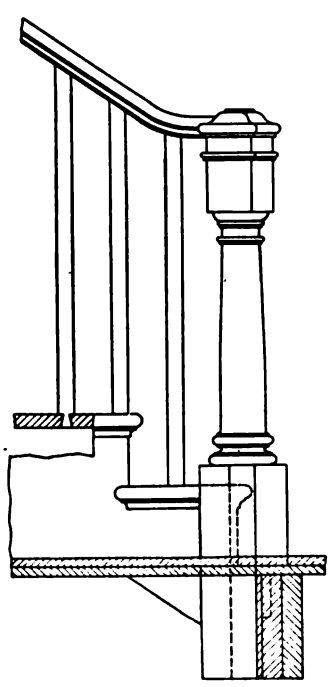
ISOMETRIC DRAWINGS
DETAIL or FRAMING

Plate 102.—In this plate are represented the top and two side views of the newel-post. So many views are not necessary to make the working drawings of this section of the staircase, but are given principally as exercises, giving the student a thorough comprehension of all the parts of the stairs, and how they go together. In making the drawings the student should first make the front and top views, from which the side views may be projected.

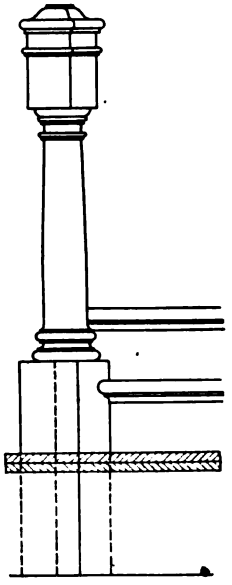
DETAIL OF NEWEL



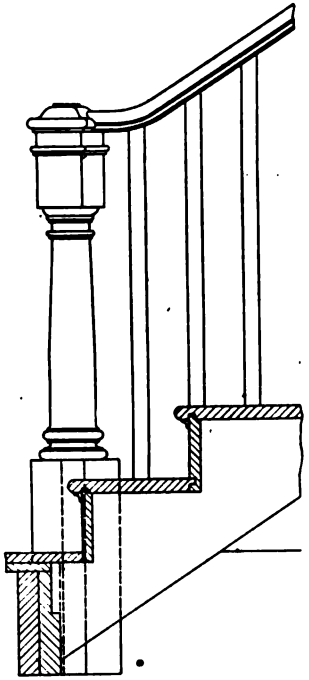
TOP VIEW



SIDE VIEW



FRONT VIEW



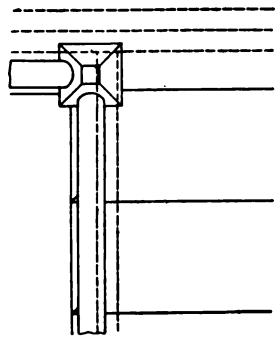
SIDE VIEW

Plate 103.—This drawing gives the front, top and two side views of the angle-post at A, Plate 98. After the positions of the risers and treads have been located in the several views, the angle-posts should be placed so as to receive the hand-rail in its proper position. The angle-post, supported by the trimmer, is housed sufficiently to place it in its correct position with the other members.

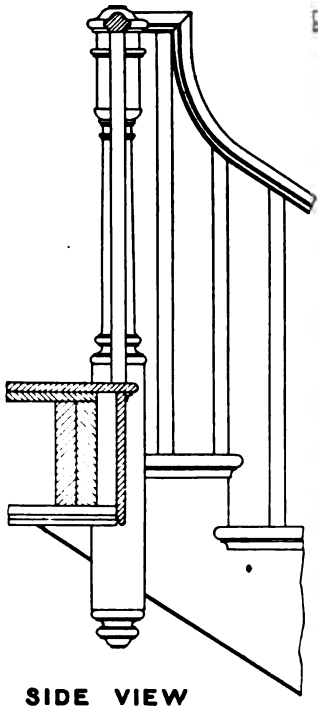
The trimmer is placed far enough forward to form a good bearing for the carriages, as shown in the side view. The hand-rail, instead of being carried in a direct line to the angle-post, takes the form of a ramp, the height of this being such that the rails on both sides of the angle-post will be on the same level.

The height of the hand-rail is about 2 feet 4 inches, or 2 feet 6 inches, measured above the tread on a line with the face of the riser. On landings the height of the rail equals the height of stair-rail measured at the center of tread; it is usually 2 feet 8 inches to 2 feet 10 inches.

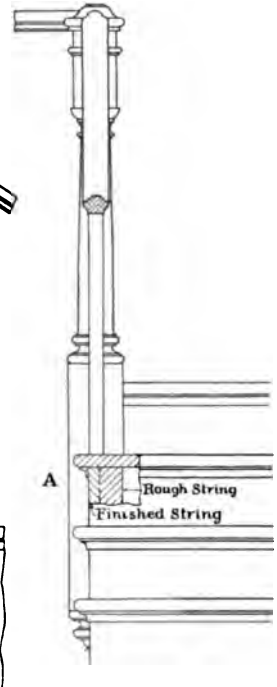
DETAIL or ANGLE POST



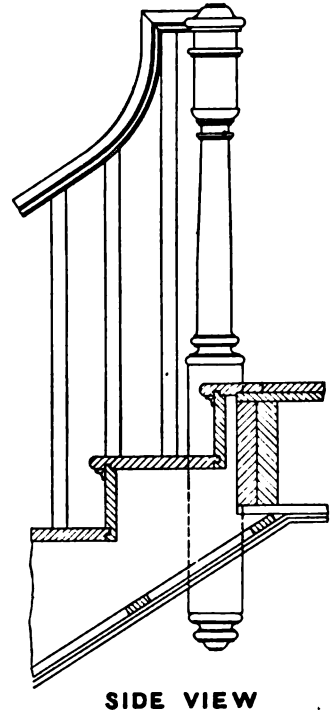
TOP VIEW



SIDE VIEW

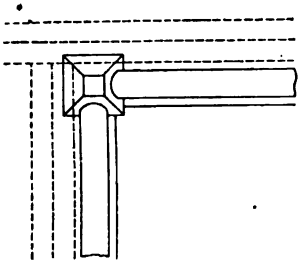


FRONT VIEW



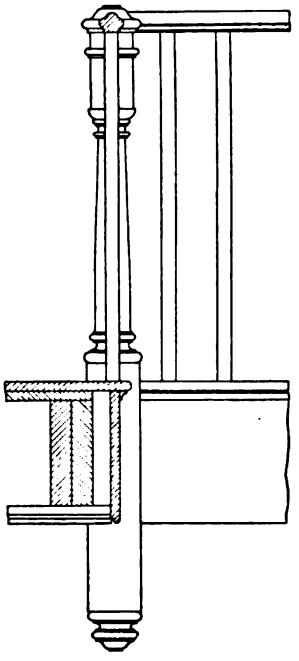
SIDE VIEW

Plate 104.—This drawing presents the front, top and side view of the angle-post at B, Plate 98. It is housed to both the header and trimmer, by which it is supported. As in the previous drawings, this should be located in position relative to the hand-rail.

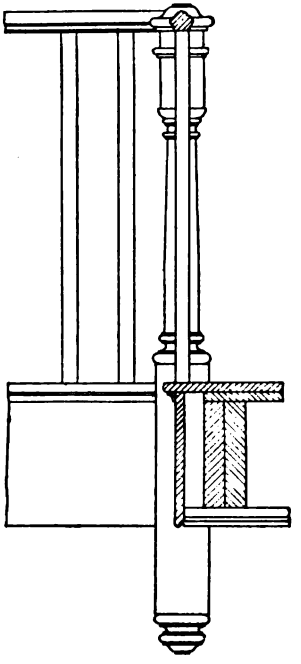


TOP VIEW

DETAIL OF ANGLE POST



FRONT VIEW



SIDE VIEW

Date

Plate 105.—This drawing illustrates the method generally followed in laying out a working drawing as practised in an architect's office. The student will note that the plan, or, more strictly speaking, the horizontal section, is placed across the front view. In practice this drawing would be made actual size.